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## ELECTRIFYING MANHATTAN.

There are those who tell the Manhattan Elevated Railroad management that they have done better to-day in placing the order for their electrical equipment than they could ever have done before. This is perfectly true, but it is no excuse for not making earlier the change to electricity that is now promised with so much good reason to start the system out on a new career of prosperity. For years past the Manhattan road has been losing business, and has in fact been paying out in dividends money that should have been devoted to the improvement of the service. A change to electricity would have checked the dry rot, and the system would have enjoyed the great increase of travel that has been the inevitable result everywhere on the adoption of electricity. Of course, the company gets better apparatus now and better engineering than it could have secured say five years ago. The advances in electricity are very rapid, and if the Manhattan Company would only wait another five years it could doubtless get apparatus then from the same manufacturers that would far surpass anything now known. There has in fact been a terrible lack of courage in the Manhattan ranks, and an amount of timidity that has cost dearly in the loss of a large percentage of travel, and that of the most profitable character. Ever since 1893 the surplus honestly available for dividends on the stock has been dwindling away; that is, in the very period when electricity has been showing to great advantage on the Metropolitan and other street railway systems. It is a great pity, for the public has suffered with the company; and there was no warrant for the long delay, granting that some hesitancy was at first pardonable.

However, the decisive steps are being taken, and we hasten to congratulate the company on its big order placed, as noted by us last week and referred to in detail elsewhere in this issue. It is to be hoped that no time will be lost in effecting the change from steam. As to the results, we have not the slightest hesitation in predicting an improvement in the financial status of the Manhattan, with consequent benefit to the public, which, through its municipal authorities, ought to meet liberally, for its own sake, the wishes of the company in regard to an extension of facilities. The underground road may, probably must, come some time or other, but meanwhile the surface and elevated systems are in existence, and should enable every one who travels to do so swiftly and comfortably without descending to the bowels of the earth. The fact that the Metropolitan system in New York in a little over ten years has been able to double its gross earnings, from $7,000,000 to $13,500,000, shows what the Manhattan Elevated has in store with electricity. The Third Avenue surface system, now electrified, should also soon show the benefits of the change. Probably the fullest effects from the resort to electric traction, with regard to the welfare and convenience of the public, will not be attained until all three systems come under one management, and transfers are freely available at all points of crossing. We can all look forward hopefully to this.

## POSTAL HIGH SPEED TELEGRAPHY.

Some months ago a very complete description was given in the pages of this journal of a high speed telegraph system then being experimented with in Hungary. It was stated, and, in fact, demon-

strated, that under favorable conditions, a speed of not less than 100,000 words an hour might be attained, or about thirty times as much as can be done by a good manual operator. The apparatus has been brought to this country since that time and some very interesting tests have been made, with the result that "machine telegraphy" is once more being boomed in great style. We are told that "Uncle Sam's post office will be the first to feel the competition, as it is intended to establish a service with this device which will enable merchants and other business men to send long messages at such low rates as to make the plan acceptable. The rate is to be made so low that a merchant could afford to send messages 1000 words in length."

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This is the ideal which we hope to live long enough to see realized, but it is not a new ideal, nor is there any certainty that the new system will bring it any nearer. Such men as Mr. Delany have long been harping on this string, and still they have not "got there." So many practical difficulties intervene that the United States Post Office can continue to struggle along cheerfully under its present deficit of several million dollars a year without being thrown into utter bankruptcy by a cheap machine telegraph system. We believe that the present telegraph companies would jump at the chance if they could be convinced that there was money in machine methods. The Wheatstone they have, it is true, and the Phelps and the Hughes, but we never encountered any very intense enthusiasm in regard to any of them in telegraphic circles.

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## ELECTRICITY IN THE NAVY.

In this issue we conclude the paper read at the recent annual meeting of the Society of Naval Architects and Marine Engineers by Naval Constructor Woodward, on the electrical equipment of the battleships Kearsarge and Kentucky, and which forms the most important contribution yet made to the subject of electrical engineering as practiced in our navy. The installations of these vessels are shown to be well fitted to their purpose, both with respect to general design and to special details such as relate to the distribution circuits and to motor accessories. An interesting part of the equipment is the application of the Ward Leonard system of control to the motors of the turret-turning mechanism. In this system, it will be remembered, the motor armature is supplied with a variable voltage; the field remaining constant for a given turning effort, the torque and therefore current are constant, while the speed is almost proportional to the voltage supplied, since it depends upon the counter e. m. f. generated, which cannot exceed the difference between the impressed e. m. f. and armature drop. It will thus be seen that by regulating the source of e. m. f. the motor can be controlled without loss of torque between no speed and full speed with no tendency to sparking, and also with a loss of energy corresponding only to that expended in the field rheostat of the generator of the variable e. m. f. On the above vessels, one of the regular service generators supplies the variable voltage, having its field, when thus employed, in series with a wide-range controlling rheostat located in the turret. It was with this system of turret control that such excellent results were obtained on the Brooklyn in the supreme test of action.

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As to the extent to which electricity is applied aboard the vessels forming the subject of the paper, its advantages have not been availed of for a class of machinery where they would be most striking—the auxiliary machinery of the propelling department. On the other hand, the opposite extreme would appear to be reached in the application of the electric motor to deck winches and boat cranes, owing to their infrequent use. When it is considered, however, that these motors do not necessarily involve any increase of the generating plant, and that their employment dispenses most probably with long lengths of steam piping, the objection on the score named loses much of its force.

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## ENGINEERING EDUCATION.

The very interesting discussion under the head of "Professional Degrees" which for some weeks has been taking place in our columns has, at least, brought out a very strong consensus of opinion on one point—that such degrees should not be granted upon graduation. On the other hand, there is wide variance of opinion as to when and under what conditions professional degrees should be conferred by engineering schools. In the opinion of some who joined in the discussion, professional degrees should be deferred until a specified time after graduation, and then only granted upon the presentation of a thesis; and others consider that evidence of having been engaged for a certain period in responsible engineering work is a prerequisite.

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The difference of opinion appears to be a natural consequence of the uncertainty which exists as to the proper method of engineering education. If the main function of an engineering school is considered to be the teaching of the principles of engineering science, leaving the acquirement of its practice until after graduation, the granting of a professional degree should necessarily await the production of evidence on the part of the applicant that he has since graduation acquired the necessary qualification for it. If, on the other hand, a course rests upon the theory that the graduate is to be fitted for responsible engineering work upon leaving school, the degree may be considered properly conferred if granted at the completion of the course, or at the most, await only such a time as may be thought necessary for the graduate to obtain a footing.

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The tendency of the times appears to be away from the latter theory of the function of engineering education, and toward that which considers the academic period as one to be devoted solely to laying a broad foundation—both by systematic cultivation of the mind and thorough grounding in the principles of the various engineering sciences—for the work of after life in any of the multitudinous channels toward which chance may direct the graduate. This latter view appears the more rational, whether we view it in relation to the success of the graduate in after life, or the dignity of the engineering profession. Engineering work requires that the faculty of judgment be well developed, and this predicates a period of apprenticeship after graduation, during which also the young man will be in contact with the details of his profession, and thus be enabled to learn them much better than they can be taught at school. An engineer has been defined as "A man of trained judgment united with technical knowledge," and this characterization is well justified when we consider that he rarely encounters a problem whose solution does not involve numerous conflicting factors, not only technical but commercial and often human ones. Moreover, any time spent in practical work at school which does not involve mental discipline or inculcation of broad principles is almost necessarily wasted. For in whatever branch of engineering the graduate may enter, he can apply but a portion of the practical knowledge imparted, corresponding perhaps to a few days or weeks of instruction in actual work, if indeed he does not have to unlearn what he brings with him as not conforming to the ideas of his employer.

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Accepting the above view of an engineer and of the function of an engineering school, it would appear that any degree which such a school confers upon a graduate should carry with it no other significance than that the recipient has completed the prescribed course of study. In the case of an electrical engineering course, this de-

gree might be called Bachelor of Electrical Engineering. As to the degree of E. E., if this were formally made the accompaniment of full membership in the national engineering body, it would be of much higher value to the possessor than if conferred by a college faculty. Whatever the graduating degree may be called, it will only be accepted as a certificate of graduation. And whatever later degree may be conferred by a faculty, it will not affect one way or another the opinion of the grantee's professional brethren, and upon this opinion his professional success through life will largely depend.

## MAGNETIC UNITS.

In a communication published in another column, Prof. Fessenden makes two suggestions which may be considered in inverted order. First, the reversion from the cumbersome existing practical system of units in terms of the quadrant, billionth-centigramme and second, in favor of the C. G. S. system for all purposes; and, second, a means for getting rid of the multiplier $4\pi$ in dealing with magnetic equations. With the first proposition we heartily agree. We hope that the next Electrical Congress will bestow suitable names upon the C. G. S. electric and magnetic units, which will enable them to be employed by those who, like Prof. Fessenden, wish to employ them in practical work, and a strong wave of sentiment seems to be forming in this direction on both sides of the Atlantic. No disturbance should arise from a christening of the C. G. S. units, and considerable advantage might accrue to the step. The next five or ten years would then show whether the advantage of the C. G. S. units would be sufficiently great to replace the practical units entirely, or whether both the C. G. S. and the existing practical system would continue to be employed side by side.

Prof. Fessenden's second proposition is of a different nature. We know that when we calculate, for example, the magneto-motive force in a magnetic circuit, we multiply the current turns by $4\pi$. The proposition is to cancel out this and other excrescences of that troublesome factor by arbitrarily taking the permeability of the ether as $16\pi^2$, or 160, nearly, in which case the magneto-motive force would become numerically equal to the current turns. The advantage would be an arithmetical simplification of various equations. On the other hand, however, the equations would still contain the objectional factor when written out in full, and from a dimensional standpoint no change would be made. The objection would be that the permeability of any substance would no longer be its specific magnetic inductivity with reference to the inductivity of the standard dielectric; namely, eter, but with reference to an imaginary body whose inductivity was $16\pi^2$. Moreover, all of the electric units, such as current, resistance and capacity, involve the magnitudes of $\mu$ or of permeability in their units. In other words, their dimensional formula contain $\mu$, so that we do not see how it would be possible to alter the magnitude of $\mu$ from the numeric unity to the numeric of about 160 without altering the magnitudes of these electric units in some measure.

## GROUNDING LOW-TENSION CIRCUITS.

In last week's number, Mr. Reed contributed a communication to the discussion which has been carried on in our colmns upon the subject of protecting low-tension circuits from accidental crosses with high-tension circuits. It seems to us that there is very little disagreement upon the real subject matter at issue, and that such disagreement as exists is upon matters of minor importance and incidental detail. Low-tension circuits are of two kinds; namely, circuits supplied by the secondary coils of step-down transformers, and so-called Edison systems. The conditions, although fundamentally alike, are not quite the same, and the two cases ought to be considered separately in detail. A secondary circuit which enters a building directly from a step-down transformer is usually in no danger of a high-tension cross except in the transformer itself. If the secondary circuit be permanently grounded, the pressure in that circuit cannot anywhere exceed the sum of the normal low-pressure plus the drop of pressure due to the intruding current on its way to ground. If, now, the intruding current is not largely in excess of the normal full-load current on the primary side, the drop in the ground circuit can only be comparatively small, and it is in the highest degree improbable that it could amount to a dangerous value; or, that a person could receive a dangerously severe shock from this drop of pressure.

As to fire risk, the fuses in the circuit would play their usual protective part in preventing the wires from carrying sufficient current to dangerously overheat them. If, on the other hand, the intruding current were much greater in strength than the normal full-load primary current, the primary fuse or fuses would be melted, and thus cut off the primary connections of the transformer and the source of the intruding current. If the permanent ground connection were cut off entirely, so as no longer to exist, matters would be just as they are now, and the protection would not exist. Any person touching the secondary circuit after a cross had been established with the primary circuit in the transformer would be liable to a dangerously severe shock, if said person stood upon or touched a grounded surface. If the permanent ground connection was not properly made and was imperfect, the drop in the circuit would be increased, but the case would be virtually that of a high-pressure circuit connected to an imperfect ground at some point, with the danger of coming into personal contact with the junction of the ground connection. The ground connection would have to be very inferior in order to communicate a severe shock with such ordinary handling as would be likely to occur in practice. The fire risk would be safeguarded by fuses just as they are at the present time.

With regard to the so-called Edison system and to secondary alternating current street mains which are practically similar to them, there is a danger of a cross with a high-tension circuit at any point along the streets. The pressure brought to bear at the house services would then be limited to the sum of the normal low-pressure in the system and the drop of pressure produced by the intruding current finding its way to ground. If the permanent ground is effective, and there is no question that such grounds could be made effective in connection with a central station or a transformer substation, it is almost impossible to imagine that this drop could be dangerously great.

If, however, any device can be depended upon in the installation of wires within a building which will instantly disconnect the house from the external supply, as soon as the difference of potential between the house wiring and the mains became sufficiently great, there would be no objection, theoretically, to its adoption instead of employing a permanent ground connection immediately outside the house. The practical objection is, however, that such a device cannot be as simple as a permanent ground connection, and would be liable to get out of order unless regularly inspected, an operation which would involve trouble and expense. Moreover, if the house wiring were not carefully inspected at intervals for insulation, there would be a danger of the device not being able to operate at the time of danger, by reason of a leakage to ground through the house wiring, whereby the requisite difference of potential could not be attained at the crucial moment. In any case, we think all will agree that interior house wiring must be protected from the effects of accidental external crosses with high-tension circuits. The most positive and most simple way of doing this is by grounding the house wiring outside the building. Any other method of protection carries with it the burden of proof as to reliability and effectiveness.

## Important Bell Telephone Plans.

Following out plans to which frequent reference has been made in these pages, although often denied, the directors of the American Bell Telephone Company have voted to turn over the assets of the company to the American Telephone & Telegraph Company. This is the first step in the removal of the company from Massachusetts back to New York. The action was taken on Dec. 1, but was not announced until the next day, when President Hudson authorized the following statement: "The substance of the action of the directors is that the assets of the American Bell Telephone Company are to be taken over by the long-distance company (American Telephone & Telegraph Company). It is to be recommended that two shares of long-distance company stock be exchanged for one share of American Bell Telephone Company stock. The balance of $19,000,000 or $20,000,000 of long-distance company stock will be held for the benefit of the long-distance company."

Mr. Henry S. Hyde, of Springfield, Mass., vice-president of the New England Telephone & Telegraph Company, was interviewed concerning the report that the Bell Company's offices would soon be removed to New York. He said: "I'm afraid it does; and I'm very sorry, too, though the move has nothing to do with the New England Company. The removal means the taking away of a large amount of taxation money, probably between $300,000 and $400,000. There is another effect. It is that the residents of this state who own American stock will now be obliged to pay taxes on it. Heretofore the company has done this." Mr. Hyde said he could not say when the offices would be removed, but that he did not expect an immediate change. Mr. W. D. Sargent, one of the directors of the American Telephone & Telegraph Company, was interviewed in New York, and said that in his opinion the new "independent" movements had had nothing to do with this action.

According to the latest figures obtainable, the amount outstanding of American Telephone & Telegraph Company's stock at the beginning of this year, in March, was $23,500,000, paying 5 per cent. The total authorized issue is $75,000,000, to which figure it was raised from $25,000,000, the amount actually issued on Jan. 1 being $20,000,000. There are no bonds. The American Bell Telephone Company itself had at the end of 1898, a capital stock of $25,886,300 and $5,049,000 in debenture bonds. If the unissued American Telephone & Telegraph stock is now emitted at the rate of 2 for 1, the operation will require $51,772,600, which added to the $23,500,000, or more, already outstanding, would absorb the entire authorized issue of $75,000,000, although the various newspaper reports all agree in alleging that the change will leave "nineteen or twenty millions in the treasury of the American Telephone & Telegraph Company to provide for future contingencies." This is true from the standpoint of the fact that the American Bell Company itself holds the $23,500,000, but it must not be forgotten that it has been issued in return for the Bell cash paid out in establishing the system and is not therefore original unissued stock.

It should be noted also that the American Bell Telephone Company held in its treasury at the close of 1898 no less than $58,776,425 of other stocks and bonds. This, however, would include the American Telephone & Telegraph $23,500,000, leaving, say, $35,000,000 of other securities that will be transferred in the deal, and that will be owned by the company in addition to its own stock thus returned to its own treasury. The total capitalization of all the Bell subcompanies is now about $100,000,000, exclusive of the American Telephone & Telegraph, which ceases to be a subcompany, and, as was long since anticipated in these columns, becomes the parent company. The expenditures of the subcompanies in expansion and new construction were $12,000,000 in 1898, and will doubtless reach $15,000,000 in 1899.

It is said that the rate of dividend on the American Telephone & Telegraph stock will be 8 per cent. This would be a fair equivalent of the present Bell dividends, which run about $15 per share, the two new shares earning $16. The American Bell Company paid out $3,106,356 in regular dividends, and $776,589 in extra, last year, while 8 per cent. on the $57,000,000 of new stock will require about $4,400,000, a sum which the growth of the business should bring within easy compass. It was stated at one time that 3 shares for 1 would be issued, but in that event the dividend rate would have had to be lower, and the market value of the stock per share would have been less. The market price for American Bell in Boston last week was around $350 and American Telephone & Telegraph 8 per cent. stock should readily bring $175, besides being more "tradeable."

## The Manhattan Elevated Electrical Equipment.

As noted in the Electrical World and Engineer last week, the order placed by the Manhattan Railway Company with the Westinghouse Electric & Manufacturing Company covers eight 5000-kw alternators, seventy-eight 550-kw step-down transformers and twenty-six 1500-kw rotary converters. This is one of the largest and most important electrical orders ever given in this country.

The alternators will develop three-phase currents at a potential approximating 11,000 volts and a frequency of 25 cycles per second. They will have stationary armatures and revolving fields. The fields will be mounted upon the shafts of four-cylinder compound-condensing engines furnished by the E. P. Allis Company, of Milwaukee, and will run at a speed of 75 r. p. m. There will be no auxiliary flywheels, the revolving element of the dynamo, which is 32 feet in diameter, having ample flywheel effect to secure the desired uniformity of speed. The effect of eliminating the auxiliary flywheel usually employed is a considerable reduction in the width of the engine and consequent stiffening of the shafts between bearings; also some economy in floor space. The outside diameter of the alternators will be approximately 42 feet and the weight 800,000 pounds. The armature winding will be of the bar type, using three bars per slot and four slots per phase per pole. The form of the potential curve during a cycle will closely approximate a sine curve. The insulation of the armature conductors is guaranteed by the manufacturers to withstand a puncture test of 25,000 volts alternating applied between copper and iron for thirty minutes. The regulation will be such that the current flowing through the armature conductors, short circuited with normal field charge, will be not less than three times the normal full load current. The machines will have an overload capacity of 50 per cent. for a number of hours without attaining a dangerous temperature.

The rotary converters will have eighteen poles and will, therefore, make a little less than 170 r. p. m. Copper shields about the field poles will be used to prevent hunting. They will be able to carry temporary loads very much in excess of their normal rating. Their fields will be compound wound to provide a certain amount of automatic regulation of the direct current potential, which will range from 575 to 625 volts. Inductance in excess of that which is inherent in the circuits will be provided by the use of reactance coils located at the power house and the substations. The rotary converters will be started from the direct current end, motor generating starting sets being provided in each substation for this purpose.

The step-down transformers will be cooled by air. They will be connected in groups of three to each rotary converter and will have overload capacities comparable with those of the converters.

No contracts for switchboard apparatus have been awarded, nor is any information yet available regarding the possible use of aluminum conductors, as the plans are not fully developed. The Technical Board of the Manhattan Railway Company feels that the plans thus far adopted comprise all the essential good features embodied in preceding large plants, while attaining certain marked advantages not hitherto realized. These advantages belong particularly to the generating sets, and the more important ones are as follows:

(1) An engine in which the rotative effect is remarkably uniform during the revolution, as it is the result of the effort of four pistons.

(2) The attainment of very uniform angular velocity in an engine having but two bearings.

(3) The elimination of the auxiliary flywheel ordinarily employed.

(4) The very high insulation of the armature in connection with a bar winding, which facilitates repairs and also secures close approximation of the potential wave to a sine curve.

(5) The use of copper shields in connection with laminated field poles and consequently strong synchronizing tendency of the alternators.

(6) Great mechanical strength of revolving element in connection with a construction which secures maximum flywheel effect with minimum weight on shaft.

It is stated that the order represents an outlay of from $1,500,000 to $2,000,000. The weight of each generating unit is put at about 1000 tons.

# The Electric Plants of the Battleships Kearsarge and Kentucky—III.

*(Concluded.)*

BOAT CRANES.

The Kearsarge and Kentucky are fitted with electric boat cranes, each having two forward, one on the port and the other on the starboard side. The capacity of the cranes is 18,000 pounds at a speed of 25 feet per minute. Each crane has the form of a large boat davit, and is built of structural steel having a box section. The lower end has a pivot steady bearing on the protective deck, the weight of the crane and its load being taken by a roller thrust bearing on the main deck, and its alignment being preserved by two steady bearings, one on the upper deck and the other on top of the hammock berthing. It is arranged generally as shown in Fig. 9.

Just above the hammock berthing the crane carries a circular platform on which is mounted all the operating machinery, the motive power being furnished by a 50-hp electric motor. The pinion of the motor meshes with a large gear on one end of a horizontal cross-shaft carried by bearings mounted on the platform; the other end of this shaft carries a worm, working a worm wheel on the upper end of a vertical shaft passing down through the platform, and carrying at its lower end a pinion meshing in a circular rack having its center in the center line of the crane, and held by the frame of the steady bearing on top of the hammock berthing. This arrangement allows the motor to rotate the crane.

There is a second horizontal cross-shaft on the platform at right angles to the one that rotates the crane, and geared to it by a pair of mitre gears near the motor end. This shaft carries a worm working a wheel on the hoisting drum, which is supported by pedestals mounted on the platform.

Each of these horizontal cross-shafts, the one for rotating the crane and the one working the hoisting drum, is divided by a friction clutch near the worm end. The disk of the friction clutch on the shaft that rotates the crane forms the pulley for a friction band brake used for braking the crane when rotating. The hoisting drum is provided with a brake consisting of a tapered wrought-iron band wrapped around a flat portion of the drum, the large end of the band being fastened to the platform and the small end being pulled taut by a weighted lever. The band is wound around the drum in the direction the drum turns when lowering; this effectually locks the drum against lowering as long as the band is pulled taut by the weighted lever, but allows it to turn in the hoisting direction with only a small amount of friction.

The following description of the crane motor is given in detail, and may be taken to represent the mechanical features of construction used on all the other motors on these ships, except the fan motors which, being in protected positions, are built of open type.

The motors are of the armored type. They have four poles, are shunt wound (with 80 volts on fields, 160 volts on the armature) and give an output of 50-hp with an armature speed of 400 r. p. m. The frame is an octagonal steel casting made in two pieces; feet are cast on the lower frame and are drilled for bolting the motor to its foundation. The upper frame is held in position by six steel tap bolts. The pole pieces are of cast steel and are bolted to seats bored in magnet frame and located at 45 degrees from the horizontal.

The brush mechanism consists of a revolving cast-iron yoke made in two halves fitting on commutator end bearing. This yoke supports four insulated brass studs which are cross-connected by flexible cable, rubber insulated and braided. Each stud has six brush holders with carbon brushes. The carbon is taken from each brush to the brush holder by a small flexible cable or "pig-tail." The brush-holder cables are rubber insulated and braided, and are brought through rubber-bushed holes in the lower magnet frame.

Three large rectangular hand-holes are cast in the upper frame immediately over the commutator, through which the brushes can be easily sand-papered and fitted. These hand-holes are fitted with cast-iron covers made water-tights by soft rubber gaskets, and held in position by bronze wedge bolts. The ends of the upper frame have semi-circular openings fitted with malleable iron covers, which are held in place by bronze cap screws and made water-tight by soft rubber gaskets. To allow for examination and adjustment of the lower brushes two circular hand-holes are cast in the commutator end of the lower frame, and are fitted with iron covers held in place by springs.

There are four field coils fitting around and held in position by the pole pieces. The coils are thoroughly covered with varnished cambric and taped, then coated with japan. Each end of the winding is soldered to a copper terminal, or binding post, for holding the field leads. The field leads are made of flexible cables, rubber insulated and braided to one-half inch diameter. The field leads are brought through holes in the frame insulated with soft rubber bushings.

The armature is of the drum-wound type, multiple connected. The core is made up of sheet-iron laminations, supplied with slots for carrying the armature conductors and supported by a cast-iron spider, which is keyed to the shaft. The core and slots are thoroughly insulated with paper and mica.

The controller is of the type referred to in a preceding installment under the head of "B" controllers.

It consists of an iron box, with a composition cover. There are two handles on top operating two cylinders, one connected with and operating the rheostats; the second or auxiliary handle simply throws the armature into two different combinations with the rheostat. The position marked "hoist" connects the armature in series, and that marked "lower" and "rotate" in shunt with the rheostat. In the first connection, which is used for hoisting, the rheostat controls the speed of the motor by choking the current as is the case in ordinary starting boxes. In the second position the rheostat is thrown across the mains and the speed of the motor is determined by the amount of resistance with which the armature is placed in shunt.

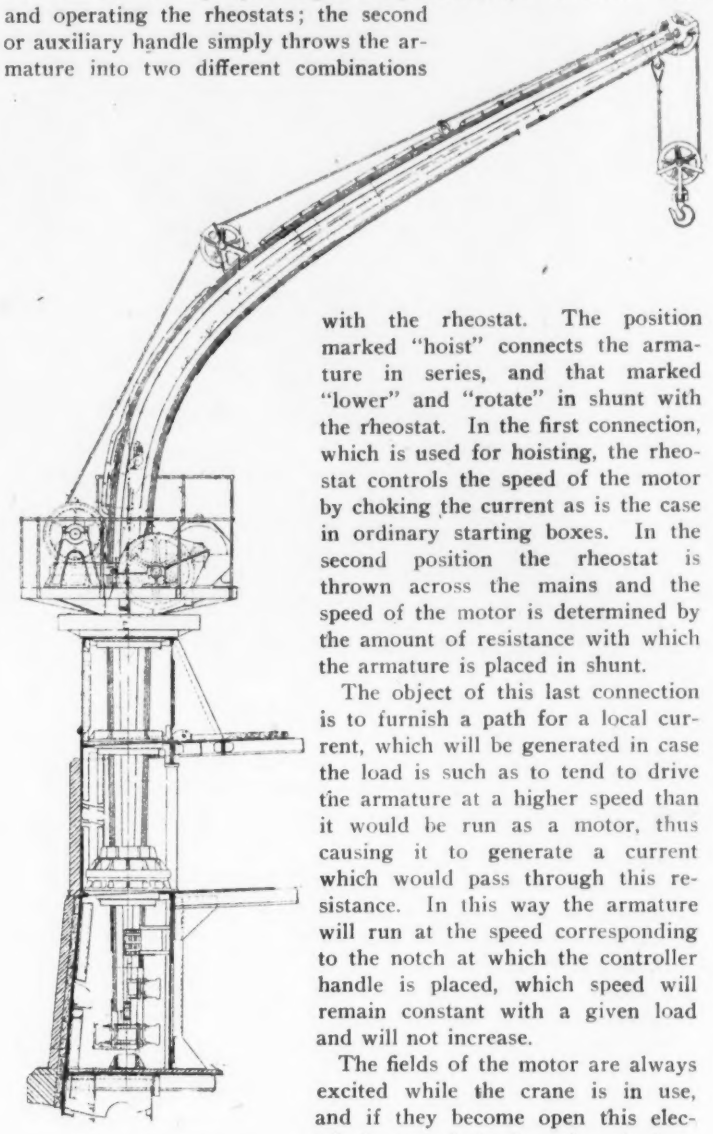


FIG. 9.—BOAT CRANE.

The object of this last connection is to furnish a path for a local current, which will be generated in case the load is such as to tend to drive the armature at a higher speed than it would be run as a motor, thus causing it to generate a current which would pass through this resistance. In this way the armature will run at the speed corresponding to the notch at which the controller handle is placed, which speed will remain constant with a given load and will not increase.

The fields of the motor are always excited while the crane is in use, and if they become open this electrical control in lowering is lost. This position of the lever gives a smoother motion in bringing the motor to a stop and is the desirable one to use in revolving the crane. The main cylinder has a connection between the contacts upon which the fingers connected with the armature touch when the controller is at the "off" position. This short-circuits the armature and electrically brakes the motor.

On the back of the controller is an iron box, with a flange projection for a coupling to a copper pipe protecting the leads. It has a removable water-tight cover. All connections to the controller leads are made in this box.

There are eight rheostats at the base of the crane. Each rheostat consists of six panels filled with ribbon resistance of desired capacity. The panels have terminals at each end for connection of leads, and also flat plates which connect the panels together. These rheostats are connected in two sets of four in series, the sets being connected in multiple, each lead from the controller branching to both sets of rheostats.

The collector rings are of rectangular section copper, put on in halves. They are mounted on wooden blocks, which are supported by a split cast-iron drum, held to the crane by four arms bolted to it. The rings are placed concentric with the axis of the crane by trial and made fast in this position.

FIG. 10.—6-POUNDER AMMUNITION HOIST WINCH.

Connection is made to the rings by studs fastened to the inside and projecting through the drum, to the end of which are clamped the cable terminals of the wires passing up the crane. The fingers supplying current to these rings are of the same type as are used in the controller. They are mounted on a fibre base supported from the bulkhead.

There are two after boat cranes, starboard and port, having a capacity of 4000 pounds at 40 feet per minute. Each crane has the same height and reach as the forward cranes, but is built lighter; all of the mechanical operating machinery is of the same design but smaller, so that the description for the forward crane applies equally well to the after crane, except in case of the motor and some of the electrical apparatus.

AMMUNITION HOISTS.

One 20-hp, 160-volt motor is located under the central girder of the turret for the operation of each of the 13-inch hoists, being supported by the bottom plate of the turret. A drum on the intermediate shaft operates the ammunition car by a flexible steel rope, passing over leading sheaves. The car travels on girder rails. The controller is of the "B" type.

The motors are of the armored type. They have four poles, are shunt wound with fields excited at 80 volts, and give an output of 20-hp at 160 volts, with an armature speed of 350 revolutions per minute. They are fitted with a solenoid brake, which consists of a cast-iron bracket bolted to the under side of the turret, supporting a pair of solenoid magnets, which when in action lift a pair of movable cores that are attached to one end of the brake lever. The fulcrum bracket that supports the brake lever is also bolted to the turret. When the current is cut off the magnets are de-energized, and allow the movable cores to fall, tightening the brake band on the brake wheel, and preventing the armature from turning. One of these brakes is illustrated in Fig. 11.

One 6-hp, 160 volt motor is located outboard of each 8-inch gun, on the gun floor under the sighting hoods, for the operation of the 8-inch ammunition hoist. The motor shafting carries a drum which operates the ammunition car by a flexible steel rope passing over leading sheaves. The drum is attached to the shaft by a clutch operated by a hand lever, so that it may either run loose or turn with the shaft, as desired. It also has a band brake operated by a hand lever.

For ordinary operation each moter operates its hoist independently, and the load is hoisted and lowered by starting and reversing the motor by means of the controller. If, however, one of the motors should be made inoperative, both hoists can still be worked by connecting in the central portion of a cross-shaft by means of the set screws in the shaft couplers at its ends, thus making the cross-shaft act as one solid piece and allowing both drums to be operated by the uninjured motor.

There are two 6-pounder winch ammunition hoists located just aft of the after barbette on the berth deck, starboard and port, one of which is shown in Fig. 10.

Each hoist consists of a cast-iron bed plate, on top of which is bolted an armored motor, and underneath the motor is located the resistance box. The bottom of the bed plate is extended and the operating controller bolted to this extension. The shaft for the drum is supported on brackets or bearings, which are part of the motor casing. Motion is communicated from the armature of the motor to the drum shaft by means of a cut cast-iron pinion, having 14 teeth, meshing into a cut cast-steel gear, having 66 teeth, and secured in an oil tight covering. On one end of this shaft is keyed the drum, which is 12 inches in diameter and has a 7-inch face. On the inner end of this drum is cast a brake flange. The brake consists of a steel band, to which is bolted vulcanite fibre; one end of the brake band is secured by means of an adjustable bolt to the operating lever, and an adjustable weight is provided at the outer end of this foot lever. The winch can hoist 120 pounds at the maximum rate of 250 feet per minute.

There are ten endless-chain ammunition hoists, situated in different parts of the ship. Each hoist consists of a pair of endless chains, traveling over sprocket wheels, and reaching from the point of loading to that of delivery. These chains support between them carriages placed at proper intervals for receiving the ammunition,

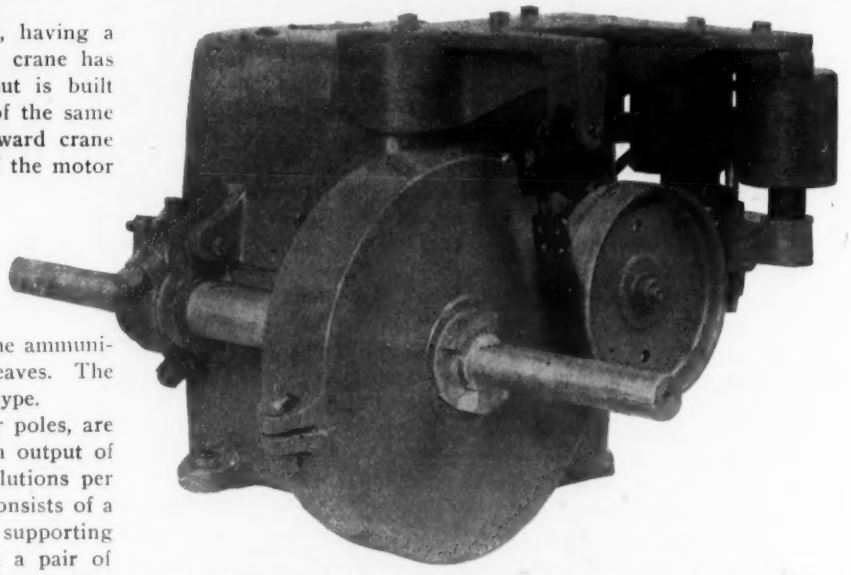


FIG. 11.—VIEW SHOWING SOLENOID BRAKE AND AUXILIARY SHAFT.

the whole being driven by an electric motor through a system of gearing. A hand gear is provided in order that the hoist may still be operated if for any cause the driving motor fails. The motor is

controlled from a controller panel similar to that shown in Fig. 5, but having a double-pole, double-throw reversing switch in addition. A solenoid brake is fitted to each motor.

One 5-hp, 80-volt, series-wound motor is located outboard of each rammer on the 13-inch gun floor. The shaft couples direct to the rammer, in the mechanism of which is a friction sheave, which may be adjusted so that in case too great obstruction is met, as would occur if the rammer reached its limit before the motor is stopped, this will slip and prevent so great a load as to causes the fuses, or circuit breaker, to act.

The motors are of the armored type. They have four poles, are series wound, and give an output of 5-hp at 80 volts with an armature speed of 775 r. p. m. The controller, of type "R," is supported

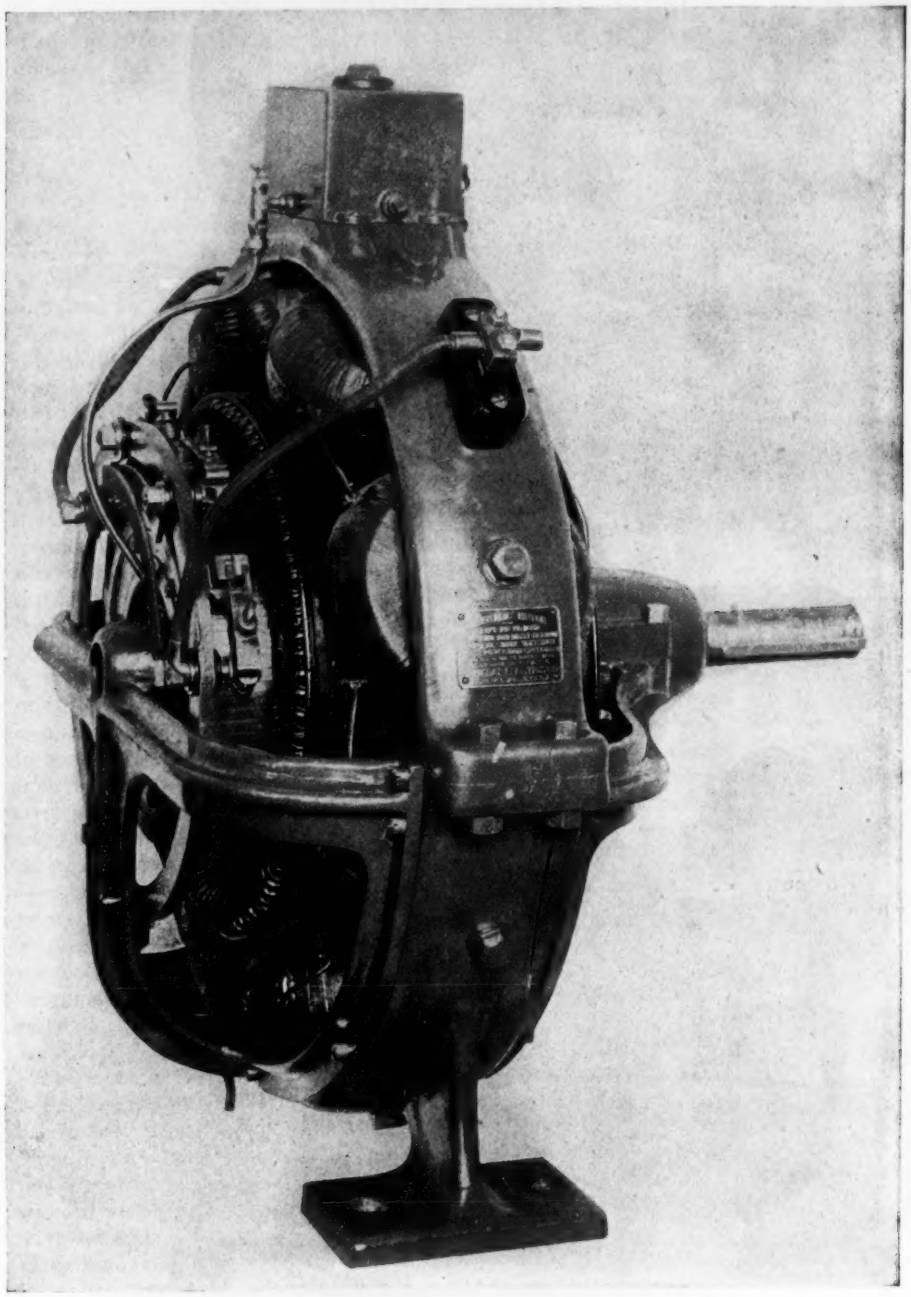


FIG. 12.—SHUNT WOUND, MULTIPOLAR FAN MOTOR.

horizontally on top of the rammer. The switch panel is mounted upon an iron framework back of the rammer and carries a circuit breaker and a double-pole switch. On the back of the frame is a rheostat.

One 2½-hp, 80-volt, series-wound motor, located in the central girder below the 13-inch gun floor, elevates each 13-inch gun. It stands with the commutator toward the centre line of the turret and drives through a pinion and train of gears. There is an idler gear inserted in the mechanism of the right gun, in order that the two motors may not be exactly opposite each other and thus render access to the brushes difficult.

It is operated by a controller situated beneath the telescope under the sighting hood. The rheostat is located below the controller and the switch panel is fastened to the mantlet plate at a convenient point. The motors are the same as those used for the 13-inch rammer, except that the field and armature have different windings so as to give a speed of 300 r. p. m. at 80 volts and 2½-hp output. The controlling devices are generally similar in principle to those used with the rammers for the 13-inch guns.

There are ten 50-inch ventilating blowers, each driven by an electric motor, and located in various parts of the ship. Each blower is direct connected to a 12-hp electric motor, supported on a shelf projecting from the side of the blower. They are set in pairs, equally distributed between starboard and port.

The motors (Fig. 12) are entirely open, shunt-wound, of the multipolar type, and having an output, with 160 volts on the armature, of 12-hp with an armature speed of 50 r. p. m. With field regulation the speed can be reduced to 400 revolutions, and by running the armature on 80 volts about one-half the above speeds can be obtained.

The magnet frame is a cast-steel ring made in two halves, bolted together by four steel bolts. To the magnet frame are bolted eight cast-steel pole pieces. Feet are cast on the lower half of the frame and drilled for bolting the motor to the blower. The brush mechanism consists of a solid cast-iron ring or yoke that slides in a groove turned in the commutator end bearing bracket. This yoke supports four insulated brass studs cross-connected by copper strips or bus rings. Each pair of studs is connected by flexible cables rubber insulated and braided. Two insulated connection blocks are secured to the side of the upper half of the magnet frame. On each stud is clamped one brush holder having a carbon brush connected to the brush holder by a small flexible cable or pigtail.

The eight field coils fit around and are held in position by the removable pole pieces. The ends of the coil are soldered to copper terminals or binding posts fitted with two screws for holding the field leads. The coils are thoroughly insulated with varnished cambric and taped, then coated with japan. The armature is of the ventilated drum-wound type, series connected. The core is made up of sheet-iron laminations provided with slots for the armature conductors, and supported on a cast-iron spider to the shaft. The core and slots are well insulated with red paper and mica. The ends of the coils are connected to the commutator by flexible cables which are soldered into the slots cut in the segments.

The motor is controlled by a motor-controlling panel, shown in Fig. 7 of preceding installment.

There are three No. 6 "Monogram" exhaust fans, each driven by an electric motor, for ventilating water closets and the steering room. Each fan is direct connected to a 3-hp motor, which is supported by four radial arms projecting from the fan casing. The fan has no outboard bearing, but is overhung and supported by the motor bearing. The motors are of the multipolar type, having an output with 80 volts on the armature of 3-hp at an armature speed of 1030 r. p. m. With field regulation the speed can be reduced to 800 r. p. m.

The motor is controlled by a motor-controlling panel. It consists of an enameled slate panel, mounted on a brass frame and enclosing two rheostats—one a starting rheostat for starting the motor, and the other a field rheostat for regulating the motor after it is brought up to speed. Its fittings are generally similar to those of the panel for the larger fans, except the minor changes incident to this motor only using current at 80 volts.

### DECK WINCHES.

There are two kinds of deck winches used, namely, "simple-geared" and "compound-geared." There are four simple-geared high-speed drum winches on the superstructure deck, and they are commonly called the "superstructure deck winches." The two compound-geared winches are located on the main deck, aft, and are

called the "main deck winches." Both kinds of winches use the same motor, controller and rheostats.

The capacity and maximum hoisting speed of these motors are: Superstructure winches, 2200 pounds at 300 feet per minute. Main deck winches, with back gear out, 2200 pounds at 300 feet per minute, and with back gear in, 13,000 pounds at 50 feet per minute.

The superstructure winches (Fig. 13) have a cast-iron bed plate, secured to which, one on either side, are two cast-iron stands or bearings; back of and between these stands and secured to the bed plate is an armored motor. This motor is geared by means of cut cast-steel pinion and gear to an intermediate shaft, which runs through bearings which are part of the motor case, and whose outer ends are supported by bearings in the stands already mentioned. The remainder of the mechanism does not differ essentially from that of the usual steam winch of modern type. Back of the motor, and attached to the bed plate, is a cast-iron column with a brass top minute at the winch head, and with the back gears thrown in, produces a rope speed of 50 feet per minute; the back gearing thus being 6 to 1. Back of the motor, located on the right-hand side for the right-hand hoist, and on the left-hand side for the left-hand hoist, and attached to the bed plate, is a cast-iron column, which, as in the case of the other type of winch, supports or guides the steel shaft extending below deck to the controller. The lever which is fitted to the upper end of this shaft is provided with a catch, operated by pressing a button on top of the wooden handle. The brass top plate is provided with a series of marks which correspond to corresponding points of cutout in the controller.

The main deck winches, one of which is shown in Fig. 14, has a second intermediate shaft. The motor running at its full speed, and with back gears not thrown in, produces a rope speed of 300 feet per

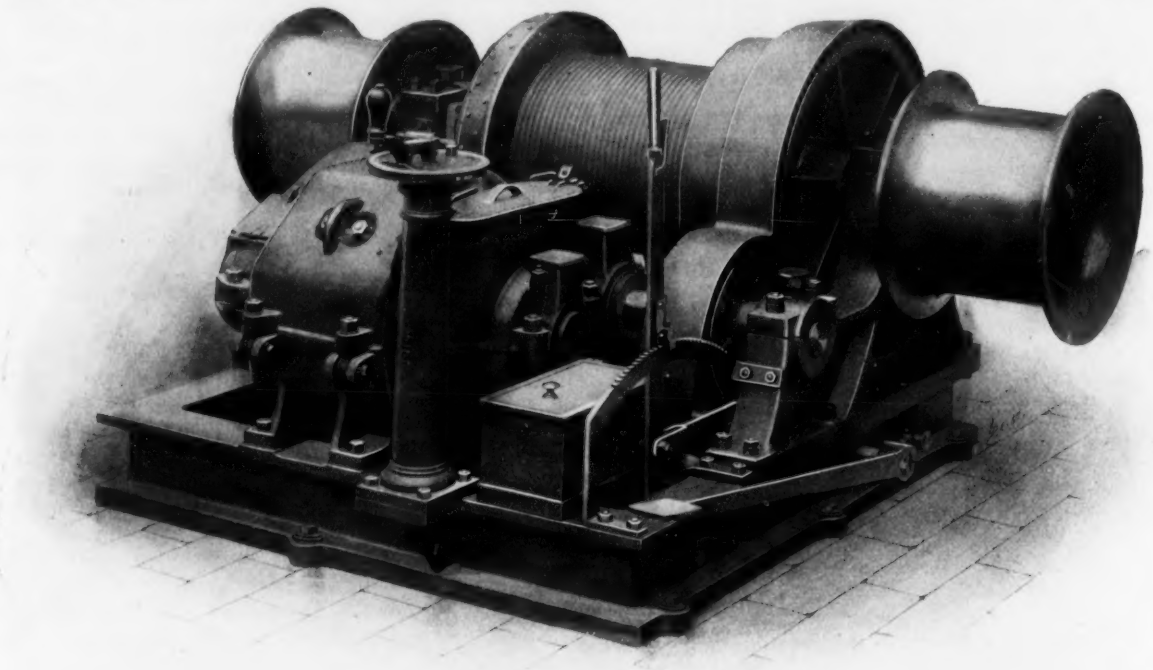


FIG. 13.—HIGH SPEED DRUM WINCH FOR SUPERSTRUCTURE DECK.

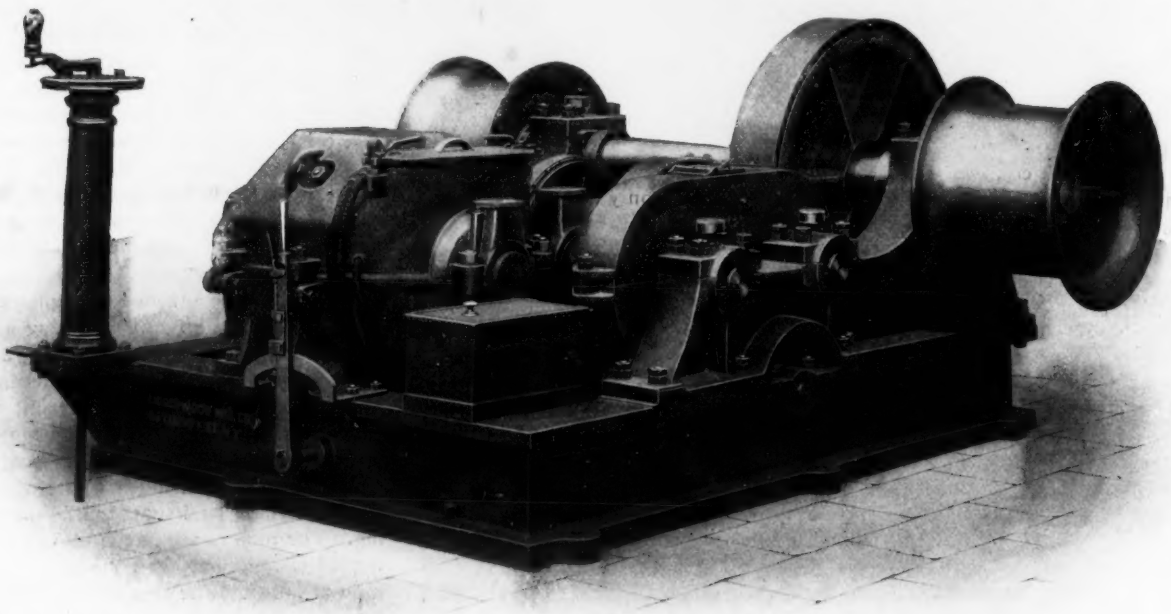


FIG. 14.—MAIN DECK WINCH.

The motors are of the armored type. They have four poles, are series wound, and give an output of 25-hp at 160 volts with an armature speed of 320 r. p. m. The controller is of type "R," previously described. It is hung horizontally from the deck, underneath the

winch, and it is connected to the vertical shaft, which carries the operating handle, by a pair of bevel gears.

Other electrical fittings aboard these vessels are Ardois signal sets, truck lights and controllers, diving lantern outfit, and an automatic centering device for the hydraulic telemotor.

In concluding his description of the electric plants of the Kearsarge and Kentucky, Naval Constructor Woodward expressed his appreciation of the efforts made by the engineers charged with the design and construction of the various parts of the electrical equipment to meet, in the best possible manner, the requirements of installation on board ship, so as to obtain that mechanical robustness of parts and freedom from the effects of corrosion, due to salt water, necessary to insure durability in service. He added that the question of the satisfactory working of the electric drive for auxiliary machinery on board ship at the present time depends largely upon the adoption of satisfactory designs for the minor details of the machines.

## Electrical Operation of Water-Tight Bulkhead Doors.

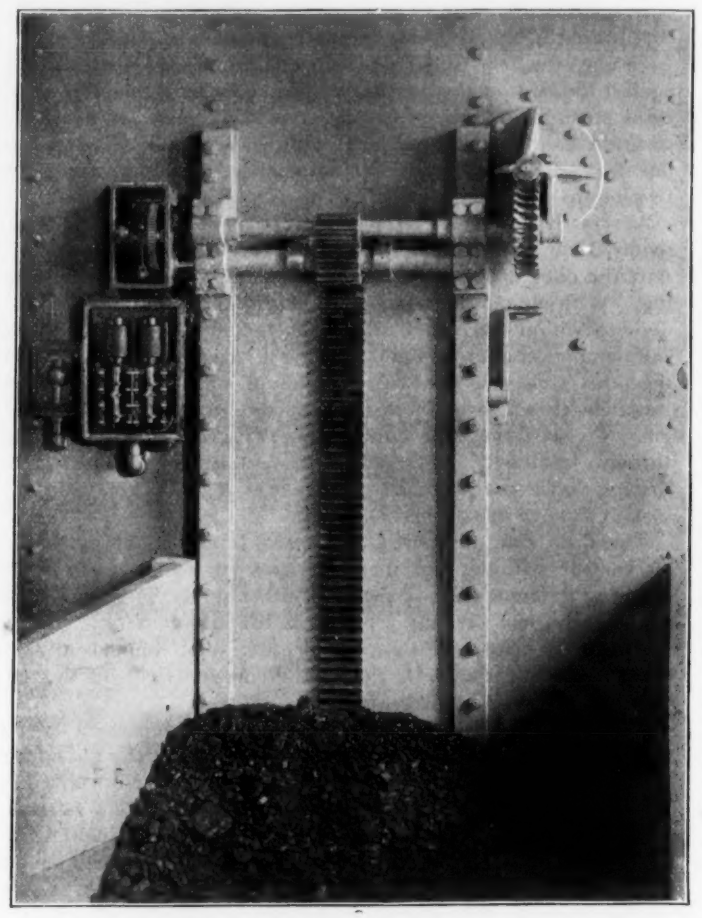
In a paper read at the recent annual meeting of the Society of Naval Architects and Marine Engineers, Naval Constructor R. M. Watt, U. S. N., in a paper on "Novelties in Ship Fittings," described an electric system for the operation of water-tight bulkhead doors. The system was devised by Naval Constructor Francis T. Bowles, U. S. N., and all of the electrical details were worked out by Mr. Frank J. Sprague, of the Sprague Electric Company. The necessary requirements for water-tight bulkhead doors are that the door shall raise or lower, by power or by hand, by one operator at the door on either side of the bulkhead; that the door shall close either against a rush of water, or against a rush of mixed water and coal, or through coal on the door sill due to first opening of a full bunker; that the operation of the emergency closing shall in no way interfere with the usual methods of operation at the door; that while the door is being closed by an operator at the distant emergency station, it shall be possible for a man at the door to stop it for egress.

Electricity was at once selected as the source of power because of the certainty of control. Cutting off the current absolutely cuts off the power; there is no waste of energy when the motors are not runing; the motor is clean and quiet, and the conductor can be run anywhere and bent around sharp corners, thereby avoiding interference with locations of other fittings. While the safety electric operating apparatus cannot be applied to all the doors of a ship without increasing the capacity of the electrical plant, a suitable increase is desirable for a complete installation, or in applying the apparatus to a new ship. As, however, the doors are operated only intermittently, it is evident that by arranging the doors to close singly, or in small groups, the apparatus can be applied to the more important doors of a ship within the limits of overloads recognized as permissible for short periods, and required in actual tests of standard electrical generators used in the United States Navy.

The electric installation presents another advantage particularly important for vessels of war. Every door is complete in itself; it has its own power line from the dynamo-room, and its own motor. Should any derangement occur, but one door would be put out of power operation; this door could be operated at once by hand without stopping to close a valve in the branch, while all other doors would continue to work under power operation as before. With hydraulic transmission, should a break occur either in the central station plant, in the main line, or in a branch, power is at once cut off throughout the system, and the power apparatus of all the doors rendered inoperative. With pneumatic transmission, should a break occur either in the central station plant or in the main line, power is at once reduced in parts of the system beyond the break, rendering power operation of doors beyond the break very doubtful.

The door as finished fulfils all the necessary and desirable requirements as above enumerated, besides the general ones of simplicity, reliability, and durability. The completed system is particularly remarkable for its simplicity and for its capacity to endure neglect. There are few moving parts, the connections are simple, the door is not liable to get out of order, and the three elements involved in its construction present no experimental features.

The door illustrated in the accompanying cut is a vertical sliding door adapated for the engine-rooms, fire-rooms, and coal bunkers of vessels. The door proper, or sliding part, is a steel plate riveted to a rim or sliding frame. The bulkhead, or guide frame, is rigidly built of bronze, through bolted to the bulkhead, the guides being tapered one-tenth of an inch to the foot. The sliding frame is made with eleven wedges, of the same taper as the guides (four on each side, two on the top, and one on the bottom), which take up in the last half inch of travel. The surfaces nearest the bulkhead of both guide frame and sliding frame are scraped surfaces, thus making a water-tight joint by the wedge action in the last half inch of closing. The guide frame is open along the lower edge, thus preventing jambing or clogging by wet soft coal. The door plate carries a bronze rack into which gears a pinion keyed to a horizontal shaft across the top of the guide frame. This pinion engages a smaller pinion keyed to a second horizontal shaft, to either end of which shaft outside the guide frame is keyed a worm wheel, which in its turn engages a worm. The worm shaft passes normally through the bulkhead, and is driven by an electric motor in a water-tight casing on the opposite side of the bulkhead. For hand operation, cranks are provided which ship over the hexagonal ends of worm shaft. The use of the worm and worm wheel does away with any possibility of creeping, so objectionable to the user of a



WATERTIGHT BULKHEAD DOOR.

door. The weight of the door complete with actuating apparatus is 1383 pounds.

The motor used is of 1-hp, compound wound, with relatively weak shunt coils wound outside the series coils. The circuits are so arranged that for raising the door only the series coils are in circuit, giving quick and easy starting; while for closing the door where it may be necessary to cut through coal, the shunt and series coils are both in circuit.

The electric current taken from the mains passes through a three-point spring lever switch. Moving the lever to the right or left completes the circuit through the motor and raises or lowers the door. The shaft of the switch handle pierces the bulkhead so that the switch may be thrown from either side. A spring returns this lever to its central position, and when in this position, the door-closing circuit may be completed from one or more distant stations

in any part of the ship. The door-opening circuit can be completed only at the door, and when completed cuts out the closing circuits.

Beyond the spring lever switch, the circuit contains a limit switch opened by a bell crank lever when the door reaches either of its extreme positions. The shaft of the pinion that engages in the door rack carries at its end another pinion that gears into a spur wheel keyed to a shaft that carries the bell crank levers for working the limit switches. The position of these levers may be adjusted for varying the lift of the door.

Beyond the limit switches, the circuit contains two Sprague solenoid gravity controllers which throw in either the series or the series and shunt fields of the motor. These controllers have carbon and copper contacts, which prevent pitting of the copper bars, but necessitate occasional adjustment of the carbon tips. The controllers are fitted in a water-tight receptacle with a hand hole and glass cover; this allows constant inspection of the carbons, and their adjustment when necessary, without removing the front of the receptacle. The working of the controllers is easy and simple, and there are no springs or pins; the copper bars are carried on phosphor-bronze flexible plates allowing for a little wear of the carbons without readjustment, and ensuring good contacts.

To close the door by hand by one operator through six inches of fine loose coal on the sill requires one minute fifteen seconds. To open the door, by hand by one operator, with about one foot of loose coal behind it, requires one minute twenty-five seconds.

To open the door fully by power, with fine bituminous coal stowed against the back of the door to within six inches of the top, requires eight seconds, the motor making 1150 revolutions per minute. To close the door from full opening, with eleven inches of fine bituminous coal on the sill, requires nine seconds, the motor making 1300 revolutions per minute.

At 115 volts, some tests showed that to start the door down required 13¼ amperes; while closing, 3¼ amperes were used. To start the door up, required 22 amperes, and 11 amperes while opening. With fine bituminous coal heaped against the back of the door to within six inches of the top, to start the door up required 24½ amperes, after which 11 amperes were taken. On opening the door wide, the coal ran through the doorway, and the door was then closed through this coal lying eleven inches deep on the sill. To start the door down required 14 amperes; while cutting through coal and within an inch of seating, 3 amperes; while driving loose coal through the hollow sill, the ammeter for an instant jumped to 52 amperes.

The door can, if desired, be closed from one or more distant or central stations, and these stations can be arranged to close doors in different parts of the ship, either singly, in groups, or simultaneously. On pressing a button at the distant station, thus completing the distant closing circuit, the door immediately starts down. When the door is closed, the current is cut off this circuit by the limit switch.

The closing of the distant control does not prevent operating the door by power at the door, because throwing the door lever to open cuts out the distant circuit and closes the door-opening circuit. As the door raises, and the man passes through, he releases the spring lever, which returns to its central position, completes the closing circuit from the distant control station, and the door closes.

An accurate and reliable indicator that a group of doors, or single doors, as desired, are closed, can be provided at one or more selected stations. In the distant closing circuit at the selected station, a small signal lamp is installed. On completing the distant closing circuit, this signal lamp either lights or remains dark. If the lamp lights, there is a positive indication that current is passing through the apparatus, and that the door must be closing. When the signal lamp goes out, or if it remains dark, the observer knows that no current is passing through the closing circuit, showing clearly either that the door is closed, or that the door-opening circuit is in operation, or that power is cut off from the actuating apparatus. If the door-opening circuit is in operation, immediately after the man passes through the door, he releases the spring lever, which returns to its central position, and completes the closing circuit, thus lighting the signal lamp. The possible uncertainty that power is cut off from the actuating apparatus is removed by leading one of the power lines through the selected station, and introducing an instrument to show power in the line. With the signal-lamp dark, and power shown by the instrument through the line, there can be no question but that the door is closed.

## Warsaw, Poland, Central Station Plant—V.

*(Concluded.)*

THE STREET RAILWAY SYSTEM.

In deciding upon the system by means of which the street cars of Warsaw may be operated electrically, five possible methods have to be taken into consideration. These are:

(1) The direct employment of continuous current, with overhead or underground conductors.

(2) Mixed operation, i. e., overhead or underground conductors and accumulators, charged during the trip.

(3) Indirect operation by means of accumulators, charged at a few main charging or supply stations.

(4) Indirect operation by means of accumulators, with rapid charging and numerous charging stations.

(5) Direct operation with alternating current (three phase).

The last-named system cannot be considered at present in view of the objections mentioned in the foregoing chapters. The indirect means mentioned in (3) and (4) as well as the mixed operations, are in no way affected by any decision reached in regard to the central station. They will be most efficient in connection with an alternating current station, in which it is possible to generate electrical energy at a minimum cost, in view of the convenient location as to coal supply and condensing water, and from which it can be carried to conveniently situated transformer stations, where the alternating current is transformed into direct and supplied to the accumulators.

The equipment of the station, however, might be affected by the choice of one of the direct methods of operation (whether overhead or underground conduit), as the distribution of the electrical energy may be effected in the following two possible ways.

(a) The generation of direct current at the station and its distribution by means of feeders to the various feeding points of the road; or

(b) The generation of alternating currents and their transformation into direct current by means of rotary transformers at such points which are conveniently located in respect to the road.

The first mentioned method has the advantage of the direct generation of the current in the form in which it is supplied to the road, namely, at a pressure of 600 volts, while the transformation, necessary in the second method, is accompanied by a 10 to 12 per cent. loss.

The direct generation and distribution of continuous currents, however, has the disadvantage of heavy current strengths and their resulting large copper conductors over long distances and regardless of this fact heavy losses in the same between the central station and the feeding points. It is further necessary, in case the lines are to be extended, to run new lengths of cables all the way from the station. At the station itself two kinds of machines are required, one set for the generation of continuous currents and one set for the generation of alternating currents and two distinct kinds of switchboards and methods of operation. All accidents which are liable to happen in the service (short circuits, grounds, lightning discharges, etc.), are immediately transmitted to the station, and could there also cause disturbances in the alternating current system. Besides, the continuous current of the road is brought in close proximity to the high tension alternating current. Finally, all the electrical energy would have to return to the station through the rails, the earth, or the return conductors and in time cause considerable damage to water and gas pipes.

The operation by means of rotary transformers has the abovementioned losses and the cost of transformer stations against it, but the following advantages:

The station would only be equipped with alternating current apparatus, and would thus be simple in equipment and operation; the station would be smaller on account of the smaller space occupied by direct current machines; there would be but one switchboard; the number of cables leaving the station would be considerably reduced; and the large feeders would not be required; the energy, in the form of high tension alternating current, would be led from the station to various points located in close proximity to the principal feeding points along the line and from which the several portions of the line may radiate in starlike fashion; the loss would probably not exceed 2 per cent., against 6 to 8 per cent. in the direct current distribution—this would to some extent counterbalance the transformer loss; the rotary transformers would have a speed of from 375 to 500 r. p. m., and would be cheaper than the large, slow-speed, direct-current machines; the transformers could be of the

small direct-current type, so that these machines could in a measure contribute to the more economical operation of the station by having the larger machines run at a fairly regular load, and have the transformers take care of the irregular railway demand for current; the arrangement in the station is similar to the common method of running a number of machines by means of belts from one engine, except that the proposed method has the advantage that instead of belts, electric current is used, which enables the direct current generators to be placed very near to those places where its current is to be utilized; the return currents would flow back to various points instead of one—this would reduce the difference of potential, also the current strength which flows back to each center, thus reducing the current strength in the ground and the liability of severe electrolytic action; the charging battery would be located close to the main feeding points of the service, and in a good position to equalize the current variations, so that their effect on the primary generators is considerably less than with the direct production of continuous currents; the location of the transformer stations would be such as to require the least amount of copper for conductors, and the system is such as to easily take care of sudden growth of traffic in certain directions by the erection of new transformer stations.

In view of all these advantages, which far outweigh the few disadvantages, Mr. Lindley advocates the use of transformer stations, in case it be decided to adopt the direct operation of the road. The transformer stations could consist either of specially constructed buildings or be located underground, or perhaps they might be installed in cellars or vaults. The equipment of a good-sized transformer station would consist of four rotary transformers, each having a capacity of 400-kw at the direct current end, with three of them in operation; therefore, the station would have a capacity of 1200-kw, or 2000 amperes at 600 volts.

The charging battery of 300 cells is capable of giving a discharge current of from 800 to 900 amperes at 600 volts for a period of one hour and would occupy a simliar space to that of the transformer station. The primary energy would be supplied to the switchboard at the transformer station from the station by a cable having a cross-section of 2x.31 square inches, or two cables, each having one-half this cross-section, and from here is fed to the alternating current end of the rotary transformers; the continuous current at the other end being delivered to the line at a pressure of 600 volts. The charging battery would work in parallel with the continuous current machines, and in case the latter could not supply a sudden extra demand for current, the battery would furnish the required amount; and in case the demand for current is below the normal, the excess of current generated absorbed by the battery.

For the charging of the accumulators two boosters will be installed which raise the voltage each night during charge to 720 volts, and in case of overcharge to 810 volts. They are designed to operate on one-third of the current generated by the rotary transformers, namely, 220 amperes at 210 volts, i. e., a maximum capacity of from 45 to 50-kw direct current. Should Case 2—that is, mixed operation—be decided upon, the above installation of transformers would still serve, but the charging battery could be reduced in size. Should it be decided, however, to adopt plans 3 or 4—that is, indirect operation with accumulators—then (a) with large charging stations and slow charging the transformers would be located at the main terminals and the charging battery be done away with entirely; (b) with numerous charging stations and rapid charging, smaller transformer stations could take the place of groups of charging stations or even single ones; in this case, they would be supplied with charging batteries to take care of the fluctuations.

### BUILDING, OPERATING AND PROFITS.

In determining the cost of operation of the plant, Mr. Lindley has taken as a basis a plant which will be able to fulfil all the requirements of the City of Warsaw for the next few years, and one which has been constructed in such a way that later additions would cause no serious losses. It is further assumed that all machinery and apparatus are of the best quality; so as to insure certainty and economy of operation. The distributing cables in all the streets are laid on both sides, and only the main streets will be traversed. All costs are based on the present price of material, and the figures given below are obtained from those given by Mr. Lindley by making each rouble equal to 51 cents. To allow for unforeseen expenses 10 per cent. has been added at the end. The calculated cost does not include house connections, as these will be paid for by the consumers themselves. It has been shown to be a wise plan, however, for the company to furnish the house connections free to all consumers enrolled during the first twelve months after the work on the plant has been begun. It has been, therefore, found expedient to add the cost of 500 house connections at 100 roubles (at 51 cents each), or at a total of $25,500.

The cost of the original plant, with a maximum capacity of 2000-kw at the switchboard, or 36,000 to 37,000 16-cp incandescent lamps, will be as follows:

| | |
|---|---|
| A.—Central Station: | |
| 1. Real estate | $24,750.00 |
| 2. Building | 280,500.00 |
| 3. Machinery | 577,500.00 |
| Total | $882,750.00 |
| B.—Net work: | |
| 1. Construction work (excavations) | $78,875.00 |
| 2. Main feeders | 79,056.00 |
| 3. Primary wires | 98,565.00 |
| 4. Secondary wires | 122,628.00 |
| 5. Transformers | 118,382.00 |
| Total | $497,506.00 |
| C.: | |
| Superintending, engineering and miscellaneous. | $132,244.00 |
| Making a grand total of | $1,512,500.00 |

The depreciation has been amply allowed for as follows:

| | |
|---|---|
| For buildings, transformer pits and street work.. | 2 per cent. |
| For steam engines and alternators | 8 " |
| For subways and conduits | 5 " |
| For conductors and accessories | 4 " |
| For transformers | 5 " |

The operating expenses have been calculated for on the following assumption:

| | |
|---|---|
| Maximum energy consumed by motors at any one time | 400 kw |
| Average number of hours of motor service | 2,500 |
| Maximum number of incandescent lamps burning at one time | 28,000 |
| Average number of hours of lamp service | 1,100 |
| Maximum capacity expressed in incandescent lamps | 36,000 |
| Which gives a total amount of energy in kw-hours for one year of: | |
| (a) For motors | 1,000,000 |
| (b) For lighting | 1,550,000 |
| The total capacity of the machines in indicated horse-power hours to produce this energy, inclusive of losses in machines and transformers at no load is | 5,970,000 |
| The coal required for this will be, in tons | 7,150 |
| Coal consumption for useful kw-hour | 5.61 lbs. |
| The labor item is divided into two parts, viz.: | |
| (a) Regular employees, and | |
| (b) Additional help during the winter months. | |
| These calculations give the following yearly expenses: | |
| First.—Five per cent. interest on the capital | $75,600.00 |
| Second.—Depreciation and maintenance | 66,900.00 |
| Third and Fourth.—Management, salaries and operating expenses | 60,500.00 |
| | $203,000.00 |

In calculating the cost of electrical energy generated by a large municipal plant, it has been found that in round numbers, one-third of the yearly expenses go toward interest, one-third toward depreciation and maintenance, and one-third toward operating expenses, and that one-half of this last item, or one-sixth of the total, goes toward the purchase of coal.

The cost, then, of producing electrical energy in this station when worked to its full capacity, and assuming that the current for motors is sold at one-quarter the price of current for lighting, will be as follows:

| | |
|---|---|
| Motor current generated | 1,000,000 kw-hours |
| Calculated at ¼ | 250,000 " |
| Lighting current generated | 1,550,000 " |
| A total of | 1,800,000 " |
| The total yearly expenses as shown above are | $203,000 |

Hence the cost per kw-hour is:

(a) For lighting current ..... 11.3 cents

(b) For motor current, ¼..... 2.82 cents

From these figures it will be seen that with a properly planned installation the city will be in a position to furnish current at a very low price.

In calculating the projects to be desired from the plant, Mr. Lindley assumes five separate periods, during each one of which some definite extension is made. He further assumes that the city will charge 5 cents per kw-hour for motor current and 15 cents per kw-hour for lighting current, with a discount of 25 per cent. on the former and 10 per cent. on the latter during the first period. He argues that in view of the increased demand for current during the second period, the rebates will be 40 and 20 per cent., respectively. In other words, during the first period the charges will be 3.75 cents for motor current and 13.5 cents for lighting current per kw-hour. After tabulating all these figures and making the proper deductions, it is found that the item for depreciation will not be covered during the first period, but that the city will be assured of a handsome profit after that time, and that the depreciation for the first period has been set at too high a figure. The large profits which will accrue from the operation of the plant after the first period can be set down for further depreciation or for the formation of a reserve fund; or, perhaps, if the prosperity of the enterprise permits it, the price for current may be reduced. It may be stated that the surplus at the end of the fifth period, i. e., after the completion of the plant, if the rebate for motor service is retained at 40 per cent., and that for lighting service of 20 per cent., will permit a reduction of the price for current to 3.6 cents for motor current and 11 cents for lighting current. In these calculations, however, the public lighting and street railway operation have not been taken into consideration. As soon as the long hours of service of these two branches are added, the efficiency and profits from the plant will be considerably increased. In regard to the time required to build the plant, Mr. Lindley refers to the time required to build the Frankfort and Elbefeld stations, the former being completed in 12 and the latter in 15 months. Knowing the capacity of these plants, Mr. Lindley is of the opinion that the Warsaw plant can be completed within two years from the time the contract is awarded. In conclusion, it may be stated that these specifications were submitted on Feb. 8, 1898.

## The Steam Engine in the Next Century.

In a paper read before the recent annual meeting of the American Society of Mechanical Engineers, Prof. Thurston said that the twentieth century will probably see a change in the rate of progress in the development of the steam engine, if not in some respects a decided halt or retrogression; and that it is perhaps even more probable that the field of the steam engine will become greatly restricted by the introduction of other heat motors, as well as by the general employment of electricity as a medium of extensive power distribution from hydraulic and pneumatic prime movers. The steam engine, he remarked, is so far perfected and the practical limits of pressure are coming to be so nearly approached by steam boiler constructors and users, that but little more can be expected of the designer. With the costlier types of engines, practically justifiable with exceptionally high cost of fuel, uninterrupted working and low values of money, as occasionally in the case of steam pumping plants, commercial practical progress seems likely to prove very slow henceforth. These types of engines must necessarily also have a comparatively narrow field. With the common case of moderate cost of fuel, intermittent duty, comparatively high value of money in the business or absolute scarcity with the buyer, gains seem likely hereafter to be rather in the direction of cheapening methods of construction and simplification of design.

## Power from the Pacific Ocean.

The Hon. Fred Peters, ex-Premier of Prince Edward Island, and E. J. Fader, of Vancouver, B. C., it is reported, have started a bold scheme to harness the Pacific Ocean. They propose to turn to account the power of the tide in both the first and second narrows in Vancouver Harbor, and to operate a large electric power house. They have applied to the government of Canada for certain foreshore rights. The federal authorities are consulting the city council of Vancouver on the matter before granting the application.

## Power Factor Measurements.

By Aug. J. Bowie, Jr.

THE definition of the power factor is the ratio of the true watts to the apparent watts delivered to an alternating system. The true watts are usually measured by a wattmeter, and the apparent watts by multiplying the volts by the amperes. Polyphase systems may be regarded as made up of single-phase circuits, each with its own power factor. Or, with balanced loads the power factor of the system may be used instead, always remembering to multiply the volt amperes by the proper constant. The cosine of the angle of lag or lead of the current is usually regarded as equal to the power factor; but this is not true in the general case, where the waves of current and voltage may have any shape, and are by no means necessarily sine waves. In order to obtain the general relations of the power factor and the angle of lag, general values of the current and voltage curves must be assumed. Let $e$ = the instantaneous value of the voltage in question. Since the two halves of the waves are symmetrical, it follows that the curve may be expressed by a form of Fourier series, by the equation

$e = A_1 \sin a + A_3 \sin 3a + A_5 \sin 5a + \ldots + B_1 \cos a + B_3 \cos 3a + B_5 \cos 5a + \ldots$ the even harmonics being left out. $a$ is a uniformly varying function of the time, and is equal to $t\frac{2\pi}{T}$ where $t$ is the time, and $T$ is the time of one cycle of the fundamental.

Similarly, the current curve may be written:

$i = A_1' \sin a + A_3' \sin 3a + A_5' \sin 5a + \ldots + B_1' \cos a + B_3' \cos 3a + B_5' \cos 5a \ldots$ Obviously, the constant may be chosen so that any particular interval of time may be taken as the origin of the time ordinates. Let these constants be so chosen that in each of the equations $e = 0$ or $i = 0$, when $a = 0$.

Now it is necessary to define what is meant by the lag angle of the current. Adopting the definition that the lag angle is the angular distance between the points where the curves of voltage and of current cross the axis of time when moving in the same direction, let $\beta$ represent this angle. Let $\beta$ be a positive quantity when the current lags behind the voltage, and negative in the converse case. Assume as origin a point where the instantaneous voltage is zero. Then the curves of current and of voltage are as follows:

$$e = A_1 \sin a + A_3 \sin 3a + A_5 \sin 5a + \ldots + B_1 \cos a + B_3 \cos 3a + B_5 \cos 5a + \ldots \quad (1)$$

$$i = A_1' \sin (a-\beta) + A_3' \sin 3(a-\beta) + A_5' \sin 5(a-\beta) + \ldots + B_1' \cos (a-\beta) + B_3' \cos 3(a-\beta) + B_5' \cos 5(a-\beta) + \ldots \quad (2)$$

The effective voltage $= E = \sqrt{\text{mean } e^2}$.

$$E^2 = \frac{1}{2\pi}\int_0^{2\pi} e^2\, da$$

Substituting for $e$ its value as given in equation (1), and performing the integration gives $E^2 = \frac{1}{2}[\Sigma(A_m^2 + B_m^2)]$,

$$\text{and } E = \frac{\sqrt{\Sigma(A_m^2 + B_m^2)}}{\sqrt{2}}$$

Similarly, the effective current $= I = \frac{\sqrt{\Sigma(A_m'^2 + B_m'^2)}}{\sqrt{2}}$.

The watts delivered $= W = \frac{1}{2\pi}\int_0^{2\pi} e\,i\, da$

$$= \frac{1}{2\pi}\int_0^{2\pi} \Sigma(A_m \sin m a + B_m \cos m a)\,\Sigma[A_m' \sin m(a-\beta) + B_m' \cos m(a-\beta)]\, da.$$

Expanding and integating gives $W = \frac{1}{2}[\Sigma(A_m A_m' + B_m B_m') \cos m\beta + \Sigma(A_m B_m' - A_m' B_m) \sin m\beta] \quad (3)$

and the power factor $P$ becomes

$$P = \frac{W}{E\,I} = \frac{\Sigma\left[\left(A_m A_m' + B_m B_m'\right)\cos m\beta + \left(A_m B_m' - A_m' B_m\right)\sin m\beta\right]}{\sqrt{\Sigma(A_m^2 + B_m^2)}\,\sqrt{\Sigma(A_m'^2 + B_m'^2)}} \quad (4)$$

Let $C_m^2 = A_m^2 + B_m^2$ and $C_m'^2 = A_m'^2 + B_m'^2$.

The effective value of the $m$th harmonic of the voltage curve $= \frac{C_m}{\sqrt{2}}$ and $C_m$ is, of course, independent of the origin assumed. Likewise, with $C_m'$

$$P = \frac{\Sigma(A_m A_m' + B_m B_m')\cos m\beta + \Sigma(A_m B_m' - A_m' B_m)\sin m\beta}{\sqrt{(\Sigma C_m^2)(\Sigma C_m'^2)}} \quad (5)$$

### SPECIAL CASES.

(a) If the curves of voltage and current are similar and proportional, then $\frac{A_m}{A_m^1} = \frac{B_m}{B_m^1} = \frac{C_m}{C_m^1} = K$ (a constant) and equation (5) becomes

$$P = \frac{\Sigma\ C_m^2 \cos m\beta}{\Sigma\ C_m^2} \qquad \ldots\ldots (6)$$

(b) If one curve (say the voltage curve) is a sine curve the equation of which is $e = A_m \sin m\phi$. then equation (5) becomes

$$P = \frac{A_m^1 \cos m\beta + B_m^1 \sin m\beta}{\sqrt{\Sigma\ C_m^{1\,2}}} \qquad \ldots\ldots (7)$$

If both curves are sine curves,

$$e = A_m \sin m\phi \qquad i = A_n^1 \sin n\phi.$$

Then, if $m$ is not equal to $n$, $W = 0$, and $P = 0$ ..... (8)

If $m = n$ then $P = \frac{A_m A_m^1 \cos m\beta}{A_m A_m^1} = \cos m\beta$ ..... (9)

Provided the assumptions of sine curves of voltage and of current are allowable, the problem of finding the power factor of a system may be solved by the use of a wattmeter alone. All that is necessary is to obtain some voltage other than the one in question, which is likewise a sine wave, and which bears a definite known relation as to phase and magnitude to the first voltage. In polyphase work, this is easily obtained.

Suppose the first voltage to be $V_1$ and the current to be $I_1$, and it is desired to find the lag $\beta$ of the current behind the voltage. (For a lead $\beta$ will be negative.) Let $V_2 = GV_1$, where $G$ is a known constant; and let $V_1$ lead $V_2$ by a known angle $\gamma$. The current $I_1$, lags behind the voltage $V_2$ by the angle $\beta - \gamma$. The wattmeter with the current $I_1$ and voltage $V_1$ will give a reading $W_1$, and with the current $I_1$ and voltage $V_2$ will read $W_2$.

By equation (9)

$$P = \frac{W}{E\ I} = \cos\beta.$$

Hence $W = E\ I \cos\beta$.

$\therefore\ W_1 = V_1\ I_1 \cos\beta$.

$W_2 = V_2\ I_2 \cos(\beta - \gamma) = G\ V_1\ I_1 \cos(\beta - \gamma)$.

$\therefore$ If the ratio of the wattmeter readings $= R$, then

$$R = \frac{W_2}{W_1} = \frac{G\ V_1\ I_1 \cos(\beta - \gamma)}{V_1\ I_1 \cos\beta}.$$

Hence $\frac{R}{G} = \cos\gamma + \sin\gamma \tan\beta$ and $\tan\beta = \frac{R}{G \sin\gamma} - \cot\gamma$ ... (10)

So that $\tan\beta$, and hence $\cos\beta$, the power factor is dependent on the ratio of the readings of the wattmeter.

In two-phase work, the two voltages which would naturally be used would be the two equal voltages, at right angles to each other. In this case $G = I$ and $\gamma = \pm 90°$, and equation (10) becomes

$$\tan\beta = \pm R \qquad \ldots\ldots (11)$$

In three-phase work, if it were desired to find the phase of the current in the $A$ leg, use voltage $AB$ in place of $V_1$, and $AC$ in place of $V_2$.

$$\tan\beta = \pm\left(\frac{R}{\sin 60} - \cot 60\right) = \pm\left(\frac{2R}{\sqrt{3}} - \frac{1}{\sqrt{3}}\right)$$

the proper sign depending on the order of rotation of the phases. It would, however, usually be desirable, not to find the lag of the current in $A$ with regard to the voltage $AB$, but with regard to the voltage half way between $AB$ and $AC$—this representing the lag of the three-phase current for balanced loads. In this event

$$\frac{W_1}{W_2} = \frac{\cos(30 - \beta)}{\cos(30 + \beta)} \text{ from which } \tan\beta = \frac{W_1 - W_2}{W_1 + W_2}\sqrt{3} = \frac{1 - R}{1 + R}\sqrt{3}. \qquad (12)$$

In order to know whether the angle $\beta$ represented lag or lead, it would be necessary to know the order of rotation of the phases. However, this can usually be told from the nature of the load. This general method, when used with polyphase work, is usually the easiest method of determining the power factor, since the ratio of two wattmeter readings is the only quantity to be determined. However, it involves the four following assumptions:

1. That the voltages used are equal, or bear a known ratio to each other.
2. That the voltage curves make certain theoretical angles with each other.
3. That the voltage curves are sine curves.
4. That the current curve is a sine curve.

The first two assumptions will usually be nearly correct. However, the last two assumptions will usually not be true, and it is of importance to see how far variations in the curves may affect the results. So a few cases will be calculated, showing: 1. The actual lag (as defined). 2. The actual power factor. 3 and 4. The lag and power factor, as calculated by equation (11). 5 and 6. The lag and power factor, as calculated by equation (12).

By assuming different values for the lag angle $\beta$, the values of the calculated angle of lag and the corresponding power factor (cos $\delta$) have been obtained for two different combinations of voltage and of current curves, the curves being given by the assumed equations. The angle $\delta$ has also been calculated from the actual power factor, which is likewise assumed to be the cosine of the desired angle. The results have been tabulated as follows:

CASE I.

$e = 10 \sin a + \sin 3a$. ..... .....Fig. 1

$i = 10 \sin a + 2 \sin 3a + \sin 5a$.... .....Fig. 2

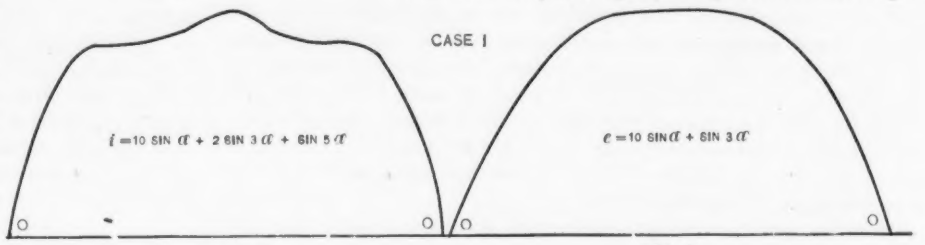



FIG. 2. FIG. 1.

$P_1$ is the actual value of the power factor, and $\delta_1$ is the angle of lag calculated from it. $P_2$ and $\delta_2$ were obtained by using the methods of equation (11), and $P_3$ and $\delta_3$ were similarly obtained by the use of equation (12).

TABLE I.—CASE I.

| $\beta$ | $P_1$ | $\delta_1$ | $P_2$ | $\delta_2$ | $P_3$ | $\delta_3$ |
|---|---|---|---|---|---|---|
| —90 | 0 | —90° | 0 | —90° | 0 | —90° |
| —60 | .466 | —62°— 13′ | .485 | —61° | .500 | —60° |
| —45 | .676 | —47°—28′ | .707 | —45° | 693 | —46°—7′ |
| —30 | .841 | —32°—45′ | .875 | —29° | .849 | —31°—57′ |
| —15 | .952 | —17°—53′ | .970 | —14°—1′ | .959 | —16°—33′ |
| 0 | .991 | ± 8° | 1.00 | 0 | 1.00 | 0 |
| 15 | .952 | 17°—53′ | .970 | 14°—1′ | 959 | 16°—33′ |
| 30 | .841 | 32°—45′ | .875 | 29° | .849 | 31° —57′ |
| 45 | .676 | 47°—28′ | .707 | 45° | .693 | 46° — 7′ |
| 60 | .466 | 62°—13′ | .485 | 61° | .500 | 60° |
| 90 | 0 | 90° | 0 | 90° | 0 | 90° |

CASE II.

$e = 10 \sin a - \sin 3a + \sin 5a$. .....Fig. 3

$i = 10 \sin a - 2 \sin 3a + 3 \sin 5a.$

$- 2 \cos a + \cos 3a + \cos 5a$.... .....Fig. 4

TABLE II.—CASE II.

| $\beta$ | $P_1$ | $\delta_1$ | $P_2$ | $\delta_2$ | $P_3$ | $\delta_3$ |
|---|---|---|---|---|---|---|
| —90 | .164 | —80°—33′ | .169 | —80°—15′ | .205 | —78°—10′ |
| —60 | .617 | —51°—52′ | .678 | —47°—21′ | .647 | —49°—40′ |
| —45 | .755 | —40°—58′ | .848 | —31°—58′ | .842 | —32°—39′ |
| —30 | .862 | —30°—27′ | .949 | —18°—22′ | .937 | —20°—31′ |
| 0 | .958 | +16°—42′ | .986 | + 9°—45′ | .977 | +12°—13′ |
| +30 | .671 | 47°—53′ | .736 | 42°—39′ | .730 | 43°— 4′ |
| 45 | .471 | 61°—55′ | .529 | 58°— 2′ | .590 | 53°—50′ |
| 60 | .286 | 73°—21′ | .315 | 71°—38′ | .331 | 70°—41′ |
| 90 | —.164 | 99°—27′ | —.169 | 99°—45′ | —.205 | 101°—50′ |

For + 90° the power is being transmitted in the opposite direction. This is the explanation of the negative power factor. The angle $\delta$ becomes greater than + 90° in this case.

The accompanying diagrams show the nature of the four curves which have been used in calculating these tables. It is evident, of course, that in general a curve of current or of voltage $a$ may cross the axis more than once for every half period of the fundamental. In this event the origin of co-ordinates assumed would be indefinite, as it might be any one of the points just mentioned. However, that would in no way alter the deductions or calculations already made, provided the relative positions of the two waves remained the same, except, of course, that a change of origin, as mentioned, would alter the assumed angle $\beta$ as given in the tables, as well as some of the constants in the equations; though the different values of $P$ and $\delta$ remained unaltered. So that $\beta$ may be considered in some cases as

merely an angle of reference, rather than having any intrinsic bearing on the subject.

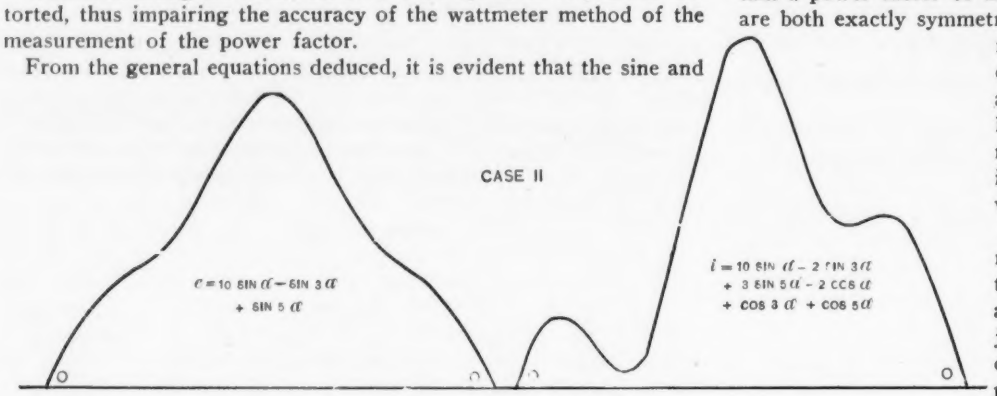
It is very unlikely in practice that the curves will cross the axis oftener than the fundamental, though it is possible to have this occur in the case of resonance.

The harmonics of the curves given have purposely been made very large, so as to exaggerate what may occur. In most cases in practice the methods given for determining the power factor will be fairly accurate, probably fully as accurate as the wattmeter, voltmeter and ammeter method, and much more so with high power factors. Moreover, it eliminates the use of three instruments, with the consequent errors involved, and substitutes the ratio of the readings of one instrument. With three-phase measurements, any two voltages can be conveniently used, and hence the two can be selected which will give nearly equal readings of the wattmeter, thus eliminating the errors of the instrument.

One point to be remembered in connection with this is the fact that in polyphase work the power factors in the different legs are by no means necessarily alike, and that even if the load consists of motors alone, that a comparatively small inequality of the voltage delivered to the motors is liable to produce large divergences between the power factors of the loads on the different legs.

With alternating arc loads, the curves are apt to be very much distorted, thus impairing the accuracy of the wattmeter method of the measurement of the power factor.

From the general equations deduced, it is evident that the sine and




FIGS. 3 AND 4.

cosine terms of the same order are parts of a true sine curve of the harmonic of that order, it being necessary to split it up into two curves, merely in order to refer its co-ordinates to the assumed origin. Moreover, it is also evident that the curves of each individual order have, as regards the wattmeter reading, absolutely no effect on those of a different order, in any way, shape or form. Hence the same results can be obtained by conceiving the sine waves of current and voltage which belong to the same harmonic combined by themselves in their proper phase relation; and then all the harmonics can be combined without having any effect on one another. However, of course, the phase difference of the voltage and current waves of each harmonic will, in general, be different from that of any other harmonic, and, provided there is a change of $\lambda$ in the lag angle, there will be a corresponding change of $m\lambda$ in the lag angle of the *mth* harmonic. The presence of a harmonic in one of the waves, which does not occur, or is very faint in the other wave, has no effect on any wattmeter measurement, and only affects the effective value of the curve to which it belongs.

In order to determine the maximum possible value of the power factor, it is evident that if there are given the curves of current and of voltage, then the power factor will be increased by eliminating from each of the curves all the harmonics which do not occur in the other curve. Also, that with a given intensity of the different harmonics, the power factor will be greatest when the harmonics of current and of voltage are in phase with each other. In this event the effective values of the current, voltage and wattage can be represented by the following expressions:

$$E = \sqrt{\frac{\Sigma\, C_m^2}{2}} \qquad I = \sqrt{\frac{\Sigma\, C_m^{12}}{2}}; \qquad W = \tfrac{1}{2}\, \Sigma\, C_m\, C_m{}^1$$

$$\text{Hence } P = \frac{\Sigma\, C_m\, C_m{}^1}{\sqrt{(\Sigma\, C_m{}^2)\,(\Sigma\, C_m{}^{12})}} \text{ and } P^2 = \frac{(\Sigma\, C_m\, C_m{}^1)^2}{(\Sigma\, C_m{}^2)\,(\Sigma\, C_m{}^{12})}$$

$$= \frac{\Sigma\Sigma\, (C_m\, C_m{}^1\, C_n\, C_n{}^1)}{\Sigma\Sigma\, (C_m{}^2\, C_n{}^{12})}; \text{ but } \Sigma\Sigma\, (C_m\, C_n{}^1 - C_n\, C_m{}^1)^2$$

$$= \Sigma\Sigma\, (C_m{}^2\, C_n{}^{12} + C_n{}^2\, C_m{}^{12} - 2\, C_m\, C_m{}^1\, C_n\, C_n{}^1)\, 2 =$$

$$2\left[\Sigma\Sigma\left(C_m{}^2\, C_n{}^{12} - C_m\, C_m{}^1\, C_n\, C_n{}^1\right)\right]$$

and is always a positive quantity.

$$\text{Hence } \Sigma\Sigma\, C_m{}^2\, C_n{}^{12} \geq \Sigma\Sigma\, C_m\, C_m{}^1\, C_n\, C_n{}^1.$$

Hence it follows that $P^2 \leq 1$, and hence the maximum value of $P$ is 1. This shows that it is impossible to obtain a power factor greater than unity, a result which is at variance with results which have been reported, where power factors larger than unity have, apparently, been found. These have always been attributed to irregularities in the waves of current or voltage; but, as is just seen, even in the general case this result is impossible, and any results to the contrary are due either to errors in the observations, or in the instruments. It is perfectly possible that instruments, when calibrated by using sine waves, may give incorrect results when the waves are much distorted.

If the two halves of the waves of current or of voltage are unsymmetrical, the even harmonics would appear in the general equations, but this would in no other way affect any of the results already obtained.

It is evident that the power factor can be unity only when $\Sigma\Sigma\, (C_m\, C_n{}^1 - C_n\, C_m{}^1)^2 = 0$, and hence when $C_m\, C_n{}^1 = C_n\, C_m{}^1$, hence $\frac{C_m}{C_m{}^1} = \frac{C_n}{C_n{}^1} = a$ constant.

Moreover, since the two curves must also be in phase in order to give the maximum power factor, it follows that it is impossible to obtain a power factor of unity unless the current and voltage curves are both exactly symmetrical and in phase with one another. This may account for the fact that in some synchronous motors it is impossible to obtain a power factor anywhere near unity at light loads, no matter how much the excitation may be varied. In fact, in some cases it is impossible to get a power factor over .5 when the motors are running empty.

WAVE FORM.—Some of the equations already deduced suggest methods by which the wave form may be obtained, though in an indirect way which may be open to objections. However, the intensity of the different harmonics may be obtained with proper apparatus. Assume the conditions in equation (6) of two similar waves of voltage and current: $W = K/2\, \Sigma\, C^2 \cos m\beta$, $K$ being the ratio $\frac{E}{I}$.

If it were desired to obtain the voltage curve, the current curve similar to it could be obtained by using a non-inductive resistance, or else a form of wattmeter could be constructed with two voltage coils. If voltages similar to the desired voltage and making different known angles with it could be obtained, then the angle $\beta$ could be varied, and $m$ different equations obtained, the solution of which would give the strengths of the different harmonics, $\frac{C_m}{\sqrt{2}}$.

However, since the resulting equations all contain the squares of $C_m$, the results would be very inaccurate, except for extremely pronounced harmonics and this method would in general be of no practical value.

However, similar voltages, which are not in phase with each other, cannot be added or subtracted in such a manner as to give similar waves in the general case.

It is theoretically possible to obtain the strengths of the different harmonics by the use of a voltmeter alone, if similar voltages, making known angles, $\beta$, with the given voltage, are obtained. Thus calling the first voltage $E$, and the second voltage $KE$, where $K$ is a quantity which can be varied at will; if these two voltages are combined in series there will result a voltage $E_l$

$e = \Sigma\, (A_m \sin m\, a + B_m \cos m\, a)$.

$K_e = K\, \Sigma\, (A_m \sin m\, (a - \beta) + B_m \cos m\, (a - \beta)$

$e_l = e + K_e = \Sigma\, (S_m \sin m\, a + T_m \cos m\, a)$, where $S_m = A_m + A_m K \cos m\, \beta + B_m K \sin m\, \beta$, and $T_m = B_m + B_m K \cos m\, \beta - A_m K \sin m\, \beta$.

$$\text{Hence } \frac{2}{E_l} = \Sigma\, (S_m{}^2 + T_m{}^2)\, /2 = \Sigma\, C_m{}^2\, (1 + K^2 + 2\, K \cos m\, \beta)/2.$$

If the voltages are opposed instead of being added, then $\frac{2}{E_l} = \Sigma\, C_m{}^2\, (1 + K^2 - 2\, K \cos m\, \beta)/2$.

By obtaining $m$ equations and solving, the values of $C_m$ could be obtained. Of course, this method is only of theoretical interest.

Assuming the conditions in equation (7), namely, that a sine wave of the frequency of the *mth* harmonic of any alternating wave is combined with the latter in a wattmeter, let $E_m$ represent the effec-

tive value of the true sine wave. Then $\sqrt{2}W/E_m = A_m{}^1 \cos m\beta + B_m{}^1 \sin m\beta$, and the maximum value of $W\sqrt{2}/E_m = C_m{}^1$.

Hence, if the phase of either wave be shifted until a maximum reading $W_0$ is obtained, then, $W_0\sqrt{2}/E_m = C_m{}^1$, and the effective value of the *mth* harmonic $= C_m{}^1/\sqrt{2} = W_0/E_m$.

In order to obtain a true sine wave of the proper frequency, a synchronous motor could be used to drive a generator at the speed of the desired harmonic. By having the generator field movable relatively to the motor field, any degree of phase shifting could be obtained. Provided accurate speed regulation could be obtained, it would be possible to dispense with the synchronous motor, and to use a generator driven at about synchronism with the desired harmonic. The wattmeter should read zero, until approaching the proper speed, when the needle should begin to swing. By adjusting the speed so that the swing was very slow, the maximum steady reading could be obtained, and the voltage could be read at the same time. However, such adjustment might be difficult, especially as the order of the harmonic increased.

If the sine wave of voltage, considered in the last case be connected in series with the alternating voltage wave, there will be a resulting voltage which will vary from $V_1$ to $V_2$ as the relative phase position of waves $E$ and $E_m$ vary:

$V_1{}^2 = E^2 + E_m{}^2 + \sqrt{2}\, C_m E_m$; $V_2{}^2 = E^2 + E_m{}^2 - \sqrt{2}\, C_m E_m$.

Hence $\frac{C_m}{\sqrt{2}} = \frac{V_1{}^2 - V_2{}^2}{4 E_m}$. So by this method voltmeter readings alone are necessary to determine the strength of the different harmonics. This is not nearly as accurate as the preceding method, however.

## How to Get Rid of the "4π" Eruption Without Changing Any of the Legal Units.

BY PROF. REGINALD A. FESSENDEN.

As far back as 1882 Oliver Heaviside, in one of his articles published in the *Electrician,* referred to the inconveniences arising from the fact that $4\pi$ enters into the equations for voltance and gilbertance. He proposed, later, that the matter should be remedied by changing the size of the units of current, voltage, magnetic flux and difference of magnetic potential. This change, whilst no doubt very desirable, has not seemed to be very practical, especially since the size of some of these units has been fixed by law.

How great the inconvenience is which this $4\pi$ factor introduces will be seen when I mention (what I shall show in a paper, to be published soon) that its retention *necessitates the use of no less than twenty-six distinct additional electrical terms, with their corresponding symbols,* all of which would disappear, without the need of introducing any fresh ones to take their places, if only the gilbertance were defined as the curl of the current and the voltage as the curl of the time rate of magnetism.

Rather than go through the years dragging this collection of mathematical junk tied to our tails, it would seem as if it would be preferable to insist on new legal definitions of the units. This would, however, doubtless meet with great opposition, and would not, with our conservative governments, take place within probably fifty years.

I have, to my great delight, found a way of getting rid of the $4\pi$'s without changing any of the legal units or creating any trouble whatever. It consists simply in taking the magnetic permeability of the ether as $(4\pi)^2$ instead of unity. (I am aware that the permeability of the air is taken as unity, but there is a mix-up here, too, as $v$ is generally taken as the velocity of light in vacuo.)

If we do this we get the following: Unit of current, no change. Unit of voltage, no change. Unit of difference of magnetic potential, $4\pi$ times as big as of old, i. e., new unit equals 1 ampere-turn. This has the advantage that it is already used in practice. Unit of quantity of magnetism, $1/4\pi$ times as big as before, i. e., same size as old magnetic line. This also is used in practice. Unit of magnetic permeability, $1/4\pi$ times as big as before. This does not hurt anything.

There is no change in any other way, and $1/k^{\frac{1}{2}}\mu^{\frac{1}{2}}$ is as before the the velocity of light in a substance of unit permeability and specific inductive capacity.

We have now no use for magnetic flux as distinguished from quantity of magnetism, or of electrostatic flux as distinguished from quantity of electricity. Consequently, the twenty-six separate and distinct electric terms above referred to, with their corresponding symbols, disappear, to our great joy and the relief of the alphabet. Moreover, the $4\pi$ does not pop up in the equations for the attraction of point charges. Instead of simply driving the $4\pi$ from one important point to another, we have practically got rid of it by sticking it onto one of the constants of Nature.

This may not seem a nice thing to do to Nature, but then she did not consider our own feelings when she made $\pi$ what it is. It is a sort of poetic justice. So far as our own convenience is concerned, the $4\pi$ is practically gone, for we can just as easily call the permeability of iron 3000 as 20.

To compare the new and old quotations, to see the general improvement:

| OLD EQUATION. | NEW EQUATION. |
|---|---|
| $\frac{\mathfrak{B}^2}{8\pi\mu}$ | $\frac{\mathfrak{M}^2}{2\mu}$ |
| $\frac{\mathfrak{H}^2\mu}{8\pi}$ | $\frac{\mathfrak{H}^2\mu}{2}$ |
| $G = \mathfrak{H}\pi In$ | $G = In$ |
| $\dot{E} = 4\pi\dot{N}$ | $E = \dot{M}$ |

Where $\dot{N}$ = quantity of magnetism, $G$ = difference of magnetism p. ct., $E$ = voltage, and $N$ the number of magnetic lines.

It thus seems to me that we have here an easy method of carrying out Heaviside's reform without making any disturbance with established things. The question is now one of "practical politics." No one will object to us electricians making the permeability of air $(4\pi)^2$, or of taking the ampere turn as the unit of gilbertance. In fact, if the powers that be have realized how great the imminence of a strong demand for reform has been, they will probably give us their blessing for not disturbing them.

Another question comes up—that is the reversal to absolute units. The practical men do not want the so-called practical units. They find them a nuisance. I would suggest, instead of calling the absolute units of quantity, voltage, etc., by new names, that we simply add the suffix ma or sta to denote that absolute magnetic or electrostatic units are meant.

Thus, the absolute electromagnetic unit of difference of electric potential would be the Volma, equal to $10^{-8}$ volts. The absolute electrostatic unit would be the Volsta. So, the Coulma would be 10 coulombs, etc.

Then I would propose a system of other affixes, to denote space, area, volume and time differentials, also configuration constants. Thus, the Volmal would be the electric intensity or volmas per cm. The Coulmar would be the quantity of electricity per cen. sq. The Coulmav would be the volume density of electricity. The Coulmat would be the time differential of quantity, or the electric current. For multipliers use Houston & Kennelly's system.

In fact, a whole system of nomenclature is thus built up just as was done by the chemists. In the paper referred to I shall give the matter in detail.

At present I would like to have criticism of both the matters mentioned, i. e., the new way of getting rid of $4\pi$ and the nomenclature.

## Steam Engine Efficiency.

In a paper recently read before the American Society of Mechanical Engineers by Prof. Thurston, a table is given showing the best economy attained up to the present year with different types of steam engines. The best performance has been from one of the Corliss type using steam at 62 pounds pressure and developing an indicated horse-power on 17.5 pounds of water per hour. A Leavitt pumping compound engine using steam at 135 pounds developed a horse-power on 12.16 pounds of water per hour, while a high-speed McIntosh & Seymour compound engine has developed an indicated horse-power on 12.76 pounds of steam per hour, the initial pressure being 125 pounds. The best showing for a triple-expansion engine was in the case of a Snow pumping engine using steam at 156 pounds pressure, and developing a horse-power on 11.26 pounds of water per hour. Of quadruple-expansion engines the best record is that of a Hall & Treat engine using steam at 400 pounds pressure and developing a horse-power on 9.67 pounds of steam per hour.

## Oscillating Current Telephony.

In a patent issued Nov. 28 to John S. Stone, a method is described of transmitting telephonic speech by developing a uniform oscillatory current of inaudibly high frequency in the primary of a telephone circuit by the disruptive discharge of a condenser in said primary; and by varying the length of the spark gap across which such disruptive discharges occur, in accordance with the sound variations. The transmitting primary circuit contains in series a condenser and inductance and a source of e. m. f. The transmitter is in shunt to the inductance and capacity, the diaphragm being connected to, say, the inductance, and a screw opposite the centre of the diaphragm is connected to the capacity. When the apparatus is adjusted for operation, the point of the screw is very close to a plate on the diaphragm, leaving only a small space as the spark gap. In operation, the source of e. m. f. produces oscillatory discharges, between the point of the screw and the diaphragm, which give rise in the telephone circuit to a uniform oscillatory current of inaudible frequency. By varying the length of the air gap, the amplitude of the oscillatory current in the telephone circuit is, of course, also varied. This feature is made use of in reproducing sound, the length of the air gap being varied by the vibration of the diaphragm caused by the sound to be reproduced, these variations being reproduced in the amplitude of the current in the main circuit. In the operation of the spark gap device for the transmission of speech, the words are uttered before the mouthpiece. The sound vibrations resulting therefrom impinge upon the diaphragm, setting it into corresponding motion, and thus varying the length of the spark gap between the diaphragm and the point. The rate of vibration of the oscillatory current is so great as not to produce an audible sound in the telephone receivers, but the latter respond to variations in the amplitude of these vibrations, and, therefore, each receiver reproduces the sound of the voice which controls and varies the spark gap in the circuit at the transmitting station. The receiving circuits are attuned to the transmitting circuit by the introduction therein of capacity and inductance.

## Independent Telephone Matters.

Interest in telephone matters during the past week has been concentrated more upon American Bell moves than upon the plans of the new opposition, which meantime has been quietly effecting and perfecting its organization. The story of the withdrawal of certain leading capitalists is said to have been exaggerated with malicious intent, and Mr. Martin Maloney has characterized most of it as absolutely false.

Articles of incorporation were filed last week at Albany for the Independent Telephone Company, with a capital of $100,000, which may be increased to $20,000,000. The route to be operated is to connect New York City with Montauk Point and other places on Long Island to the east; the Ohio State line to the west, and the Canadian line to the north, all within the state, and it may extend to other points of the United States and other countries. The directors are Frederick Myers, James Russell, C. W. Phillips, Henry Ten Eyck Wendell, of New York City; Franklin Noble, Charles Tremaine and James C. Merwin, of Brooklyn. None of the incorporators would give any details except to say that they proposed to go in to get a part of the business in a very profitable field. A representative of the Telephone, Telegraph & Cable Company said that the new company had no connection with the Maloney enterprise. He thought that the new company may have been formed in the interest of the Bell company.

Negotiations are said to be pending for a consolidation of the United Telephone & Telegraph Company, recently incorporated by Baltimoreans under the laws of New Jersey, and the Federal Telephone & Telegraph Company, which also has a New Jersey charter. The former company has a capital stock of $5,000,000, and the latter company a capital stock of $10,000,000. Alexander Brown & Sons are said to be conducting the negotiations on the part of the United Company. Mr. Alexander Brown has stated that the negotiations are far advanced. The United Company will absorb the Maryland and Pittsburg and Allegheny telephone and telegraph companies, and plants in Wilmington, Del., Alexandria, Va., and Jersey City. It will also establish service in Philadelphia, Washington and other cities. The Federal Company is backed by influential western capitalists, and has options on several plants in the west. It is proposed after the consolidation to establish long-distance communication between St. Louis, Pittsburg, Washington, Baltimore and other cities. The United and Federal Companies are independent of the Bell Company, and it is understood that they have no connection with the Telephone, Telegraph & Cable Company of America.

A despatch from Cleveland, O., of Dec. 1 says: "A meeting of the shareholders of the recently organized Federal Telephone Company will probably be held here within a few days to discuss the proposed consolidation between that company and the Telephone & Telegraph Company of America. Henry A. Everett, one of the heaviest backers of the Federal Company, speaking of the proposed deal, said: 'It is possible that the Federal will not combine with the big company at once. It may be some time before the consolidation is effected, but if the Federal Company is not a part of the combination from the first, there will be a contract for the two companies to work together that will make the position of the Federal Company perfectly secure.'"

At Trenton, N. J., on Nov. 29, the New York & Philadelphia Telephone, Telegraph & Cable Company filed articles of incorporation with the secretary of state here. The capital is given as $100,000, and the papers state that the company intends to build and operate telephone and telegraph lines in New Jersey. The New York & Philadelphia Company is a branch of the Telephone, Telegraph & Cable Company of America.

Considerable excitement was manifested early this week in the newspapers of New York City over the alleged drawing-in of telephone cables into the Metropolitan Street Railway conduits, but no confirmation can be obtained. Cables are not made in a day nor can they be laid with secrecy. It is essentially a very public exhibition. Some time ago the Metropolitan laid spare cables uptown supposed to be for lighting. In the meantime, as actual news, it may be stated that the Knickerbocker Telephone Company has taken the whole Astor Building at Broome and Elm Streets for its work, and that it has its eye on other sites for exchanges. This building is several stories high, and provides room for an exchange, offices, storage, etc. The Knickerbocker Company is working in close touch with the Maloney syndicate.

## Applications of Wireless Signalling.

Almost every day new applications of electric waves are reported by the daily press. Among the latest is the alleged invention of a Mr. A. F. Hamilton for the purpose of facilitating approach to the harbor of Halifax, N. S., which is frequently difficult of access. The apparatus consists of what may be called an electrical buoy on which is a bell connected with the land by means of a submarine cable. In addition to the bell the buoy is intended to hold a Marconi transmitter from which signals may be sent from land to a distance of four or five miles. In this manner all vessels provided with receivers suitable for wireless telegraphy can not only be readily warned of danger as they approach the coast, but can also ascertain their exact situation by paying due heed to the signals transmitted. In a despatch from Chicago, under the head of "Marconi Tests Are Outdone," an account is given of tests of a wireless telegraphy by Prof. W. S. Johnson and C. L. Fortier, of Milwaukee. What these gentlemen accomplished, according to the information at hand, is this: "They succeeded in telegraphing without wires through a suite of seven rooms, with all doors closed, and through seven walls. Another test was made, when the signals were conveyed through three fireproof vaults and an ordinary telegraph switchboard, in which thirty wires were connected up and about forty dead wires were located. Notwithstanding the fact that this switchboard contained live wires, the current passed through all of the vaults and through this board. This probably is the most severe test ever given wireless telegraphy. A third test was made, in which the sending instrument was placed inside of one of the steel vaults and both doors were closed and the combination lock turned. The signals were then transmitted clearly from the inside of the vault to an adjoining room." The professor claims that his invention is materially different from that of Marconi, and that an instrument can be constructed to be carried on horseback. Other information tells of another system of wireless telegraphy tested at Lexington, Ky., by Prof. G. R. Sturtevant. The system, Prof. Sturtevant says, possesses qualities superior to Marconi's system, in that instead of transmitting in waves which travel in every direction sent, the messages are sent in parallel lines in two directions, and cannot therefore be taken indiscriminately by persons not intended to receive them. The system, he says, originated in England.

## Rapid Growth of Telephony.

The Bell Telephone instrument statement for the month ended Nov. 20 shows:

| | 1899. | 1898. | 1897. | 1896. |
|---|---|---|---|---|
| Gross output ..... | 69,117 | 35,159 | 29,023 | 15,185 |
| Returned ..... ..... | 19,992 | 15,486 | 7,817 | 9,073 |
| Net output ..... | 49,125 | 19,673 | 21,206 | 6,112 |
| Since Dec. 20: | | | | |
| Gross output ..... | 608,715 | 313,522 | 214,897 | 178,346 |
| Returned ..... ..... | 183,263 | 135,568 | 84,068 | 84,872 |
| Net output ..... | 425,452 | 177,954 | 130,829 | 93,470 |
| Total outstanding ... | 1,550,702 | 1,097,475 | 904,678 | 770,016 |

For the month ended Nov. 20 the Bell Telephone Company put out the largest number of instruments in a single month in the history of the company, namely, 69,117, as above. This is also a noteworthy month by reason of the fact that the number of instruments outstanding crosses the 1,500,000 mark. The month of March this year holds the record for the largest net output for any one month, namely, 53,503 instruments. The net output for November was 49,125. Last March the company was 10,000 instruments behind its orders, but last month the company received orders for 51,000 instruments and put out 67,000.

The Erie Telephone system reached 100,000 subscribers on Nov. 24 and will probably close the year with 105,000. Erie Telephone people feel very confident that the list will number 150,000 at the close of next year. Nestor, the California contract agent, pledged 60,000 subscribers' contracts for construction department work in 1900.

The Bell Telephone system of the United States will close the year 1899 with 600,000 subscribers, a gain of 122,000. Of this amount the Erie system will make one-third of the total gain for the year.

## CURRENT NEWS AND NOTES.

*TROLLEYS IN ITALY.*—The Italian government, through its railroad department, has granted concessions to the Thomson-Houston Electric Company for the construction of about fifty miles of electric road in various parts of Italy.

*PACIFIC CABLE.*—In the annual report of Mr. W. H. Wilson, superintendent of the Queensland telegraph service, the subject of the proposed cable from Canada to Australasia is discussed. It is strongly urged that Great Britain shall join with Canada and Australasia in providing the necessary funds, and it appears that recently such an arrangement has been concluded. It is pointed out that this cable would afford an alternative route to the east passing entirely through territory under British control; the importance of which from a strategical point of view is manifest, and that the possession of the first cable across the Pacific is a matter of the highest commercial importance. Moreover, Mr. Wilson believes that the cable cannot fail to promote imperial unity.

*WAR COAST SIGNAL SERVICE.*—A reprint has been published of Prof. G. F. Sever's interesting paper on the work of the United States Coast Signal Service during the war with Spain, which originally appeared in the *Columbia Engineer.* The paper gives the organization of this service, and includes various official reports made concerning its operations. As will be remembered, signal stations were established during the war with Spain along the North Atlantic coast, which were manned by volunteers many of whom were drawn from the electrical profession. The result showed that the coast signal service fulfilled a useful purpose, even in the absence of any enemy along the coast, and in case of actual invasion its service would have been invaluable.

*SHUNT MOTORS FOR ELECTRIC RAILWAYS.*—A patent was granted Nov. 28 to Emile B. W. Reichel, of Berlin, Germany, on a system for the operation of electric railway cars by means of motors connected in shunt relation. The armatures of two or more propelling motors are connected through suitable controlling mechanism between the mains, and the fields are excited by a separate and independent source of current. In each of the field circuits a rheostat is placed which is adapted to control the individual circuits and adjust the respective motors to operate at a constant speed. The exciting current is supplied from a motor-generator, the motor side of which is connected in the main circuit, and thus the potential of the secondary circuit may be maintained at any desired value independent of any variations in the potential of the main circuit.

*PRECIOUS ORE TREATMENT.*—It is stated that a discovery in ore treatment, made by Dr. J. A. Ogden, of Philadelphia, who has been experimenting at Deadwood for a year or more, is destined to work a revolution in the method of extracting the precious metals from pyritic or iron-carrying ore. In the small plant now in operation all the particles of iron are drawn out of the powdered ore by magnetic action, thus withdrawing the materials which are usually a detriment to the successful reduction of the ore, and leaving nothing but sand and the gold or other values. As many of the ores in the Black Hills contains 80 per cent. of iron to the ton, the magnetic separation would concentrate five tons of raw ore into one ton of sand and precious metals. The iron being out of the ore, the sand and values can be run over the amalgamating plates and practically all of the gold will be caught by the quicksilver. Mr. Edison is understood to have been at work on something of the same kind.

*THE CUBAN CABLE MONOPOLY.*—The Boards of Trade in various western cities are taking steps to break the cable monopoly to Cuba now enjoyed by the Western Union Telegraph Company. The movement was started by the Kansas City Board of Trade, and other bodies of like character are agitating the matter. The Kansas City organization called the attention of the Secretary of War to the fact that that city, with other western cities, were being discriminated against in the matter of cable tariffs. They were charged, they said, 50 cents a word for messages to Cuba, while the rate to all points in Great Britain, Ireland, France and Germany was 34 cents a word. Under these conditions the president of the board in his communication asked Secretary Root to rescind the order of former Secretary Alger preventing the Commercial Cable Company from landing a cable in Cuba. The Boards of Trade at Los Angeles, Cal., and Harrisburg, Pa., have also passed resolutions asking Congress to take such action as will permit the landing of a competing cable on the coast of Cuba.

*FORTUNE TELLING BY TELEPHONY.*—Some clever Romanys recently outwitted the city authorities of Milwaukee. That city has an ordinance prohibiting fortune telling. For some time the roving bands of gypsies settled just over the city line, and there the women of the bands have waited for the credulous who wished a peep into the future. But the dollars came slowly, and the wits of the gypsies were taxed to overcome the obstacle of transportation. They solved the problem by engaging a room in the city and installing there a long-distance telephone, which was connected with one in the gypsy camp outside the city limits. Word was quietly passed around, and soon there was a steady stream of patronage. The police learned of the scheme, but reasoned that they had no evidence on which to base a complaint of violation of the ordinance. The fortune teller is beyond the pale of the law, and it is not her voice that speaks at the receiving end of the telephone, but a metallic reproduction of it. Moreover, only the fool at the city end of the telephone wire knows the nature of the communication sent.

*CONSTANT-CURRENT TRANSFORMER.*—A patent was issued Nov. 28 to Richard Fleming on the details of construction of constant-current transformers. In this type of transformer, one of the two coils, generally the primary, is fixed and the other coil is movable. As the load on the secondary changes, the repulsion between the primary and the secondary varies, and the movable coil will promptly adjust itself with respect to the stationary coil so as to maintain the current in the load circuit constant. This arrangement of the coils will also compensate for changes of e. m. f. in the main circuit, for as the current varies in the primary, its repelling force varies and the secondary will assume a new position. In the type of transformer patented, the movable secondary is supported by a pair of floats, each consisting of a semi-circular airtight tank made of thin sheet metal. The casing containing the coils and float is filled with oil which submerges all the working parts. By balancing the weight of the coil by a float submerged in this oil, the relative effect of the friction between the moving and stationary parts is reduced to a minimum. In addition to assisting the coil in its vertical movements, the oil acts as an insulator and also as a cooling medium to keep down the temperature of the transformer.

*A BUILDING FUND* is being pushed by the English Institution of Electrical Engineers, which has already $27,000 in hand for that purpose. It is suggested that members pledge themselves for a definite amount of a term of years, the scale providing about $20,000 a year. The body would then encroach no longer on the generous hospitality of the Civil Engineers.

*WOMEN IN ELECTRICITY* is the subject of an interesting article in the New York *Sun*, but when it has mentioned Mrs. Hertha Ayrton, in England, and Miss Bertha Lamme, here, there is an end of the list of feminine electrical engineers. Prof. Crocker says he doesn't see why, nor do we, it is such a nice, clean profession. In electrotherapy there is Dr. Margaret Cleaves, but she again stands very much alone in that department of work.

*ELECTRICAL DEVELOPMENT IN JAPAN.*—Mr. Robert A. Ross, of Montreal, who has just returned from China, Japan and British India, in the interests of a syndicate of capitalists, says that he comes back with the impression that outsiders can do nothing in Japan, in the way of electrical railway development, as the Japanese people are fully abreast of the times. They have sent their men abroad, have learned about all that can be taught them, and have already established electrical schools and have tramways in their largest cities, besides electric light, telegraphs and telephones.

*HYDROFLUORIC PRIMARY BATTERY.*—A patent was issued Nov. 28 to E. L. Anderson on a primary battery, having for an electrolyte a solution of hydrofluoric acid or borohydrofluoric acid. The negative electrode consists of carbon in the form of a cylinder, surrounding which is a cylinder of lead forming the positive electrode. The electrolyte consists of one part of hydrofluoric acid mixed with three parts of water. To the solution enough boracic acid is added to saturate the hydrofluoric acid, about one part of the former to two parts of the solution. The electrolyte also contains a source of oxygen such as chromic acid, potassium permanganate or atmospheric air, which is placed into the solution direct or into a closed carbon cup.

*THE YUKON TELEGRAPH LINE.*—Some interesting information respecting the telegraph line to the Yukon is given by Mr. J. B. Charleson, of the Public Works Department, Ottawa, who superintended its construction. The exact distance from Bennett to Dawson is 740 miles, and the cost of the line about $137,000. There were no horses engaged in carrying on the work of construction, most of the carrying being done by scows on the river. Where the Big Salmon enters the Yukon, the former had to be crossed, the distance being 900 feet, the very rapid current preventing the laying of a cable, so the wire was strung above the river at a height of 70 feet. Connection was made with Dawson at 6 o'clock on the evening of Sept. 28, and on that evening $400 was taken for messages. The line has already netted the Dominion Government nearly $15,000.

*PRIMARY BATTERY COMPOUNDS.*—Four patents were issued Nov. 28 to Henry Blumenberg, Jr., on primary battery compounds. One compound consists of ammonium chlorate and aluminum tersulphate, the latter keeping the electrodes practically free from incrustation. Another consists of sulphate of aluminum and chlorate of potassium, which is said to result in great constancy of current. A third compound consists of ammonium chloride and a bisulphate of the metals of the alkalis and aluminum tersulphate. The advantage of this compound consists in preventing detrimental incrustations of oxichloride of zinc on both the carbon and zinc poles, which incrustations increase the internal resistance and eventually make the cell practically useless. The fourth compound consists of chloride of soda, bisulphate of soda and chlorate of soda. The advantages of this compound are stated to be that a cell supplied with it recuperates quickly and has low internal resistance, incrustation of the electrodes being also prevented.

*INDICATION OF ALTERNATING-CURRENT LINES.*—A patent was issued Nov. 28 to Ernest G. P. Oelschlager, of Westend, Germany, on a system for indicating the voltage of alternating circuits at the centres of distribution, which closely resembles the Mershon method. The primary of a small transformer is connected at, say, the generating station in series with one of the conductors of the main circuit. In series with the secondary is connected a resistance and inductance, which are proportioned to the resistance and inductance between the generator and the centre of distribution. At one side the resistance and inductance in series are connected with one terminal of a voltmeter, the other terminal being connected to the second conductor of the line. When the primary and secondary of the transformer and the resistance and inductance are properly proportioned, the drop between the terminals of the voltmeter will be proportional to the drop at the point of the working circuit which is to be indicated; consequently, the voltmeter connected at the terminals of the miniature system in the central station may be made to correspond in its readings to a voltmeter connected at the given point of the working circuit.

*POWER FROM THE BRITANNIA RAPIDS.*—The transformation which will ultimately result in utilizing the Britannia Rapids, near Ottawa, for commercial and manufacturing purposes, is progressing very rapidly. The Metropolitan Electrical Company, of Ottawa, which began operations there early last spring, is rushing the work with a full capacity of men and teams. The plant being used in the construction of the company's power canal is one of the most modern and complete obtainable. There are five steam drills, three steam derricks, a steam dredge, two locomotives and fifty flat cars, comprising part of the plant, and with these facilities the big force of men is making great headway on the big rock cutting. The total length of the canal is about 3000 feet, but only about 1200 feet of this is solid rock, through which there is a cutting of about 150 feet wide and varying in depth from 8 to 14 feet. In the blasting of this rock about one ton of dynamite is used per day. It is now estimated that the whole work will be completed in the spring and the company will be ready to deliver power by May 1. Specifications for the wheels for the power house are ready, and tenders will be called for shortly. The construction of this canal is probably the biggest hydraulic work that has ever been done on the Ottawa River.

*TELEPHONE CIRCUIT.*—A patent was issued Nov. 28 to J. J. Moller, of Kiel, Germany, on an improvement in the details of a telephone circuit, whereby the receivers remain in circuit during calling without loss of call bell or battery current and without any interference with the call bell or battery circuit—at the same time enabling the sender to ascertain if the receiver is busy. In combination with the main line is a signal branch permanently grounded; a telephone lever switch normally connecting the latter to the main line; a three-point switch normally grounded; a branch in parallel to the signal branch, including a receiver terminating at the three-point switch and adapted to be connected to line through the telephone lever; and a special branch permanently grounded and adapted to be connected to the line through the three-point switch branch containing the telephone and telephone lever switch. With the telephone on the hook, the lever switch connects the line with the signal circuit. With the telephone off the hook, the line is connected with the induction coil and receiver as usual, but a three-point switch enables a battery to be introduced between the receiver circuit and ground. In the latter case the sender with the receiver at his ear can hear a vibration of the diaphragm of the receiver due to the intermittent current in the line caused by the make-and-break at the bell at the called station.

*SAYERS REVERSING POLES.*—A patent was granted Nov. 28 to W. B. Sayers, of Beardsden, Scotland, on details of his method of applying small auxiliary poles to a dynamo in order to bring about the reversal of the currents in the armature sections at the required times in whichever direction the armature may be running and whether as a generator or as a motor. This consists in fitting small pieces of magnetic material to the leading and trailing pole pieces. These reversing poles are mounted in close proximity to the field magnet poles but separated therefrom by an air gap, and are so arranged as to be readily adjustable, both as regards the distance between each pair and the distance of the reversing pole faces from the armature. The arrangement is such that the reversing pole pieces are magnetized initially by the field magnet poles, but to a lower degree than these poles; in the case of a generator, the trailing pole piece is strengthened and the leading pole piece weakened and even reversed in sign by the armature current, and in the aggregate the effect is the same as if the two reversing pole pieces had had initially no magnetism. This arrangement brings about the reversal of the currents in the armature sections at the required times in whichever direction the armature may be running and whether as a generator or as a motor. The principle concerned was covered in a previous patent, the present patent relating to details of construction.

*PENNSYLVANIA STREET RAILWAYS.*—According to recent statistics of the Pennsylvania Street Bureau of Railways, the total mileage of street railways in that state is 1,493.21 miles, against 1,422.84 last year; number of employees, 12,506, against 12,680 a year ago. Total compensation of employees for the fiscal year ending June 30, 1899, was $6,569,904, against $6,542,840 last year. Number of passengers carried during the fiscal year ending June 30, 1899, was 473,313,258, against 432,779,314 in 1898.

*AWARDS AT EXPORT EXPOSITION.*—Silver medals and diplomas have been awarded to the following concerns at the Philadelphia Export Exposition in the class of electrical machinery and apparatus: Patrick Carter & Wilkins, electrical goods; C. J. Toerring Company, arc lamps; General Electric Company, electrical goods; Jandus Electric Company, Cleveland, O., electric lamps; Helios Electric Company, electric lamps; Cutter Electric Manufacturing Company, electrical goods; Standard Underground Cable Company, Pittsburg, electric cables; Wagner Electric Manufacturing Company, St. Louis, electrical goods.

*PROPOSED FRENCH CABLES.*—A special cable dispatch from Paris of Dec. 2 says: "The absolute dependence of France upon England for news of the Transvaal war, owing to the fact that the cables are under the control of the English, has greatly irritated public sentiment. The colonial commission has urged the government to take immediate steps to equip France with cable communication with her colonies, in the following order: A line uniting France with Senegal, another with Madagascar and a third connecting Tonkin with the Danish company's cables. These, the commission says, are an urgent necessity, and afterward will be needed lines between Senegal, Konakry, Grand Bassam, Kotonoa and the Congo, while another should connect Indo-China with Djibouti and Madagascar. The commission also strongly advises watchfulness in the Pacific, so that the French possessions may be brought into cable communication with the metropolis by means of American and German lines. Twenty-five million dollars would be needed to carry out the project. Increase of commerce is expected to cover the outlay, but, with true French logic, it is claimed that whether trade warrants it or not the work should be undertaken for the purpose of national defence."

*SYSTEM OF DIRECT-CURRENT DISTRIBUTION.*—In a patent issued Nov. 28 to Ernest Wilson and J. M. Cater, of London, England, a system of distribution is described, the object of which is to provide for maintaining a constant potential difference between any two points in a working circuit during charge or discharge of a storage battery connected with such circuit. A motor-generator serves as a link between the generating and battery circuit and the working circuit, and is provided with two field coils so arranged as to magnetize the field magnet in opposite direction; one of these is a series coil and the other a shunt coil. Calling the two leads from the dynamo *A* and *B*, the storage battery is connected between these leads and the working circuit comprises the lead, *B*, and a third conductor, *C*. The series coil of the generator end of the motor-generator is connected between *A* and *C* and the shunt coil between *A* and B. When the storage battery is supplying current to the working circuit, the series field coil is alone connected and the storage battery current is increased to maintain the potential difference between *B* and *C* constant. When, however, the storage battery is being charged by a current from the main generator, the shunt magnetizing coil is automatically cut in and the electromotive force supplied by the motor-generator is thereby reduced, thus maintaining the potential difference between the conductors of the working circuit constant. In other words, the motor-generator supplies the line e. m. f., in one case being driven by the storage battery and in the other case by the generator, and supplying a constant potential to the line; whereas, if the line were supplied directly from the generator or storage battery, the e. m. f. in one case would be different from that in the other.

*INCANDESCENT LAMP FILAMENT.*—A patent was issued Nov. 28 to William L. Voelker, of London, England, on a new type of incandescent lamp filament and process for making the same. The essential materials consist of the carbides of uranium and thorium. Two parts of chemically pure nitrate of the earth metal selected are combined with one part by weight of pure cane sugar and dissolved in distilled water. The solution is then heated to the boiling point, when the mass will swell to a porous body largely increased in bulk, and presenting, if uranium nitrate be employed, a yellow color. This body spontaneously ignites and while burning gives off great quantities of nitrous fumes. When the fumes cease to be evolved, the vessel is covered with a porcelain lid and the mass allowed to cool slowly. When cold it is of a brownish-black color and is soft and porous. The mass is then ground to a find powder and sufficient cane sugar added to give it a consistency of putty. It is then pressed into cakes, slowly dried and baked hard in covered crucibles. The next operation consists in melting these cakes in a suitable electric furnace. The current required to reduce from 6 to 8 ounces of the compressed mass to a perfectly fluid body in about 15 minutes should be approximately about 1000 amperes at from 75 to 100 volts. When the whole mass is in a perfectly fluid state, the current is cut off and the furnace allowed to cool down. The reaction in the furnace will have produced a carbide, which is next reduced with benzol or naphtha and ground to an impalpable powder. When the grinding is complete the powder, freed of benzol or naphtha, is mixed with a viscous compound composed of gun cotton and oil of cassia and then rolled for about an hour between hard or polished steel rolls. Upon the completion of the rolling, the mass is transferred to a strong sealed cylinder provided with a tight-fitting piston and a filament is squirted through a jewel die and wound on suitable forms of gas carbon. The filaments are then heated to a bright red color by means of an electric current of high voltage in an atmosphere of purified and attenuated gas. The surface of carbon deposited from the gas is then volatilized at a very high temperature and in a vacuum, thus finally completing the union of any uncombined carbon with the carbides in the core of the filaments by bringing them to the highest degree of incandescence. It is stated that the resulting finished lamps give in comparison with the best carbon filament lamps a much higher candle-power with a great reduced consumption of current, the electrical resistance of the carbide filaments being so much higher. The carbide filaments are said also to have greater stability at the resulting high temperature, and the economic life of the lamps is thus greatly lengthened. For producing incandescent electric lamps yielding a pure characteristic light, uranium carbide filaments are employed, which give a light having an appearance of sunlight. The whiteness of the light can be increased by adding thorium nitrate to the uranium nitrate. If it be desired to increase the electrical resistance, titanium nitrate may be added.

# LETTERS TO THE EDITORS.

## Regulating Electric Railway Motors.

*To the Editors of Electrical World and Engineer:*

Sirs:—Pardon me if I call your attention to an error in a descriptive note in your issue of Oct. 28, 1899, page 658, of the electric railway controller recently invented by me. It is there stated: "A further movement of the controller switch causes the free end of the resistance to be connected across the adjacent group of battery cells, this connection being a transition step to the next position, in which the armature with the resistance in series is connected across two groups of battery cells, while the field remains connected as before."

The connection referred to is not a controller-handle position, but instead, is to be regarded, like the resistance connection across a group of cells, as an intermediate step. My system is valuable for the very reason that rheostats and the losses connected therewith are omitted, while if the operation were as described in your note this would not be the case. M. F. A. KUBIERSCHKY.

BERLIN, GERMANY.

## The Uses of the Series Field Winding of Compound Dynamos.

*To the Editors of Electrical World and Engineer:*

Sirs:—I note that your editorial in the issue of Nov. 25, page 808, on the uses of the Series Field Windings of Compound Dynamos anticipates the suggestion of Mr. McAllister, on page 852 of the issue of Dec. 2, of using this coil for rectifying the field of a generator, the polarity of which has been reversed.

Permit me to say, however, that all of this is fully set out in the patent, No. 527,075, Oct. 9, 1894, issued to William B. Potter, the present principal railway engineer of the General Electric Company.

Mr. Potter's patent, I believe, first describes the advantages of using the series coil rather than the shunt for throwing in a new generator, and explains the reasons why this is to be preferred.

NEW YORK. T. J. JOHNSTON.

[The specification of the patent above mentioned first refers to the common method of running continuous-current machines in parallel, which is to start them all at once and allow the potential to rise gradually, which method, when the machines are thus started simultaneously, is simple and effective; but when, in a large station, several generators are already running, and a load comes on suddenly, it is not an effective method of starting a single generator, or one or more generators to run in unison with those already supplying the circuit. In starting up the station there is generally sufficient time before the load begins to come on, to enable the engineer to avail himself of the residual magnetism of the machines, and by the use of a shunt field, build up one or more of the generators to proper potential, after which they may be thrown into the work circuit, and the effect of the series coil and the shunt coil adjusted to a proper balance. This, however, is a somewhat slow process, the saturation curve of the field magnets when energized by the shunt alone, running almost in a straight line at first for a considerable time and then rising quite suddenly to the full magnetization obtainable by the use of the shunt alone. When the station is started, however, under light load, and a heavy load comes on, it is imperative that no time be lost in switching in more machines, and therefore it is impracticable to run the generators which are to be switched in for a sufficient length of time to attain this degree of magnetization by the shunt alone. It is also objectionable to get the entire magnetization from the shunt field because when the equalizing connection is made or when the series coil is thrown into operation by connecting the machine in circuit, its effect is so great as to very greatly over-compound the machine, and as a result the machine just thrown in takes practically the entire load, and it becomes a matter of difficulty to distribute the load between the different machines, the indexes of the ammeters varying back and forth and rendering the adjustment of the shunt coil to bring the machines into accord a matter of judgment and skill. It has been proposed to avoid this difficulty by employing a separate excitation for the machines as they are thrown in, but this is undesirable and introduces unnecessary complication in the switchboards and other apparatus. The inventor states that by his method the difficulties pointed out are avoided, and it also dispenses with the cost and complication of the separate excitation.

One of the claims of the patent is for a method of throwing compound dynamos into multiple relation, which consists in energizing the series coil of the idle machine with current from the machines already in operation; then building up its magnetization by its shunt coil; then throwing the machine into circuit; and finally adjusting the load between the different machines. Another claim more in detail is for a method of throwing compound dynamos into multiple relation, which consists in closing the equalizing connection between the idle machine and the others; closing the connection to the positive busbar, thus throwing in its series coil; then closing its field-switch and adjusting the shunt so that the machine generates current of approximately full potential; then throwing the machine into circuit by closing the connection to the negative busbar; and finally adjusting the machines until their loads are equalized.—EDS.]

# DIGEST
## OF
# CURRENT ELECTRICAL LITERATURE.

By CARL HERING.

### DYNAMOS, MOTORS AND TRANSFORMERS.

*Theory of Alternators.*—BLONDEL.—A French Academy paper developing a theory of polyphase alternators, with special consideration of the armature reaction. The m. m. f. of the armature current is assumed to be constant and two parts of the magnetic flux due to this m. m. f. are distinguished from each other; the "direct flux" which also passes through the field coils, and the "transverse flux" which surrounds only the armature coils, but not the field coils, hence it passes between both circuits. Whether the direct flux is greater than the transverse flux, or vice versa, depends upon the phase relation in the armature circuit. If the armature current is in phase with the e. m. f., the whole flux due to the armature m. m. f. is transverse, and there is no direct flux. If, however, a phase difference of 90° exists between the armature current and the e. m. f., the whole flux is direct, and there is no transverse flux. (This is explained very clearly in Steinmetz's Alternating Current Phenomena, pp. 242 to 244.) For any phase difference between 0 and 90°, the armature reaction is considered as the resultant of the reactions of a direct flux due to the wattless component of the current and a transverse flux due to the energy component of the current. By transverse flux he means only that part of the flux surrounding the armature coil, which passes transversely through the end of the pole pieces and only distorts the field but does not magnetize or demagnetize it. The third part which is the stray field, and outside of the armature, passes only through the air, he assumes to be proportional to and in phase with the current. He therefore distinguishes between three different coefficients of self-induction; the first relating to the transverse flux and corresponding to the energy component of the current; the second relating to the direct flux and corresponding to the wattless component of current, the third relating to the stray flux. The fundamental differential equation of his theory states that the drop of voltage in the armature is obtained by combining the e. m. f. consumed by the effective resistance with the e. m. fs. induced by the variation of the three magnetic fluxes.—*Comptes Rendus*, Oct. 16; *L'Eclairage Elec.*, Oct. 28; *L'Elec.*, Nov. 11.

The first part of a somewhat more extended illustrated exposition of this theory. In a diagram he illustrates the phase relations between the different components of current and e. m. f., the stray field self-induction coefficient being neglected. From this diagram equations for the phase difference between the e. m. f. and the current, for the e. m. f. and for the voltage at the terminals, are developed. He further treats graphically the special case in which the external load is non-inductive.—*L'Ind. Elec.*, Nov. 10.

POTIER.—A French Academy paper in which he points out that Blondel's introduction of more than one coefficient of self-induction is intended to show the variation of the self-induction coefficient. Instead of these, Potier assumes only one coefficient, but one which is variable, and treats analytically the case that the e. m. f. of the given source of power is sinusoidal and that the coefficient of self-induction varies inversely as a certain periodic fluctuation of the time. The article is purely mathematical.—*Comptes Rendus*, Oct. 23; *L'Eclairage Elec.*, Nov. 4.

*Capacity Limits in Direct Current Machines.*—ADAMS.—An article of a general nature on the two limits of output of continuous current dynamos, which are determined by the heating and by the sparking of the brushes. In practice the maximum rise of temperature over the surrounding air, allowed in the windings of electric machines, is 90° F. To allow for temporary overloads, it is customary to so design dynamos that the sparking limit permits of a somewhat greater output that the heating limit, especially in machines intended for intermittent work, as for crane motors.—*Eng. News*, Nov. 23.

REFERENCES.

*Surging of Parallel Connected Alternators.*—BLONDEL.—Referring to the article of Boucherot (Digest, Nov. 18) he reproduces a formula which he had developed in 1892 and which is somewhat more general than that of Boucherot. The latter's formula is a special case of the general one of Blondel.—*L'Eclairage Elec.*, Nov. 11.

*Alternating Current Motors.*—GUILBERT.—A continuation of his article (Digest, May 27) giving short illustrated descriptions of recent improvements taken from patent specifications.—*L'Eclairage Elec.*, Nov. 11.

### LIGHTS AND LIGHTING.

*Arc Lamps for Interiors.*—It is recommended to use large globes of frosted glass, and to run the lamp inverted, that is, with the positive carbon at the bottom when the greater part of the light will pass to the ceiling and be reflected; the loss is said to be 35 to 40

per cent. Enclosed arcs are not recommended on account of the unsteadiness produced by the traveling of the arc around the carbons. The currents to be used with indirect diffused illumination depend upon the required brightness and the space; for continuous current lamps of 8 to 12 amperes, and a room 13 feet high, the following figures are given: For 10, 20, 30, 40, 50, 60, 70 and 80 meter candles, 2.4, 3.5, 4.9, 6.7, 8.6, 10.7, 13.2 and 16.4 watts per square meter.—*Elec. Tech.*, Oct. 31.

*Arc Lamp.*—An illustrated description of a focusing arc lamp mechanism of Siemens & Halske. Steady burning is said to be attained by great freedom of motion and sensibility in the regulating mechanism. Friction is overcome by introducing two spiral springs acting upward on either side of the pivot, thus balancing each other and supporting the weight of the moving parts.—*Elek. Rund.*, 16, p. 187; noticed, with illustration, in *Science Abstracts*, November.

REFERENCE.

*Moore Vacuum Light.*—ELSTER and GEITEL.—An illustrated abstract of the article noticed in the Digest Nov. 18.—*Elek. Zeit.*, Nov. 16.

## POWER.

*Three-Phase Plant for a Watch Factory.*—An illustrated description of the light and power installation of the Elgin National Watch Co. Three-phase, star-connected current is generated, three wires leading from each point of a star and a neutral wire from the centre. Between the three wires a pressure of 220 volts is obtained, while the voltage between the neutral wire and any one of the three wires is about 127 volts. This system permits the use of incandescent lamps on the 127-volt circuits and induction motors on the three-wire distribution. There are three generators with a total capacity of 350-kw; the three-phase current has a frequency of 7200 alternations per minute.—*West. Elec.*, Nov. 25.

*Electric Crane.*—A short description of a 50-ton overhead traveler, recently made for an English boiler shop. The total weight of the crane is 95 tons when fully loaded. The electric equipment contains three series-wound motors each with its independent resistance, the hoisting motor running at 300 revolutions per minute, the cross traverse motor at 300 revolutions, the longitudinal motor at 600 revolutions, which slow speeds involve expensive and large motors, but eliminate the high gear speeds otherwise necessary.—Lond. *Elec. Rev.*, Nov. 17.

REFERENCES.

*Electric Cranes.*—The first part of a well illustrated description of movable and stationary cranes. Different methods are described to enable small, cheap, high speed motors to be used, and the starting is to be gradual. Some recently installed English cranes are illustrated and described.—Lond. *Elec. Rev.*, Nov. 17.

*Electrical Driven Silk Loom.*—An illustrated description of one used in Switzerland driven by a half-hp three-phase motor by gearing. It has proved to be so satisfactory that it has been definitely adopted in the silk factories of Switzerland, Italy and Austria.—Lond. *Lightning*, Nov. 16.

*Corliss Engine.*—A very long and full description of its construction and operation, with many illustrations and tables.—*The Eng.*, Nov. 15.

## TRACTION.

*Waterloo and City Electric Railway.*—JENKIN.—An abstract of a paper read before the English Institute of Civil Engineers, giving an account of the electric equipment of this London electric underground railway. The electric energy is generated in the power station at the Waterloo end by high speed engines coupled direct to two-pole dynamos and transmitted to the trains by a third rail, consisting of an inverted steel channel carried on porcelain oil insulators. The feeders and third rail for the up and down lines are independent of each other; there is also an independent system of feeders and distributing mains for lighting the tunnels and stations, the trains being lighted from the circuit supplying power to the motors. The current from the motors and lamps is carried back by the running rails, which are bonded and connected in parallel throughout. Each train consists of two motor cars, one at each end, and two trailers between them. Each motor car is carried by two four-wheeled bogies, and one bogie on each motor car is fitted with two series-wound motors, the armature being built directly on the scale of the driving wheels, with the field magnets surrounding it fixed in position so that they move in a horizontal plane with the bogie, but cannot rotate; no reduction gearing is used. The speed of the trains has been limited by a rigid system of block signaling and by a decision of the Board of Trade requiring a maximum speed of not more than 15 miles an hour around the sharpest curves, while the whole electrical equipment of the line had been designed for a speed of 24 miles at these points.—Lond. *Elec. Eng.*, Nov. 17.

*Overhead Construction for Trolley Lines.*—WOODFIELD.—An article giving a summary of present English practice. The regulations of the Board of Trade require that the trolley wire shall be supported at intervals not exceeding 120 feet and that the minimum distance between it and the surface of the street shall not be less than 17 feet. In general, steel poles are used, 31 feet long, and made up in either three, two or one section. The sizes and tests of the poles usually adopted are mentioned. The usual size of the trolley wire is No. 0 B. & S. hard drawn wire. The conductivity should not be lower than 98 per cent. of pure copper; the breaking load should not exceed 21 tons per square inch, which gives 3750 lbs. for No. 0 B. & S. wire. In sweating on the earth, a lamp should never be used, as this is very liable to overheat the wire and harden it. The Board of Trade rules on guard wire are noticed. He questions the advisability of putting up guard wires, as in his experience he has never known it to prevent a falling telephone or telegraph wire from becoming charged. He states that considerably more than 50 per cent. of the accidents on electric tramways are caused by the guard wire. The span wire generally consists of a strand of seven No. 12 S. W. G. galvanized steel wire, having a breaking strain of about 3360 lbs., and the sag should not exceed one-thirtieth of the span. The conclusion of the article gives particulars concerning the fittings used in overhead work and of the section insulators, which are required by the Board of Trade rule that the trolley wire shall be divided up into sections not exceeding half of a mile, between every two of which shall be inserted an emergency switch.—*Lightning*, Nov. 16.

*Dutch Electric Railway.*—A note stating that the success of the German line between Duesseldorf and Krefeld, which is the first high speed electric railway in Europe (Digest, July 22, Aug. 12), has induced a Dutch German syndicate to elaborate a scheme for the construction of a double-track main electric railway between Rotterdam, The Hague and Scheveningen. The concession to build the railway is said to have been granted; it is proposed to adopt a mean speed of 31 miles per hour, thus enabling the journey between Rotterdam and Scheveningen to be accomplished in 35 minutes.—Lond. *Elec. Eng.*, Nov. 17.

*Mountain Railway in India.*—With reference to the proposed Kashmir railway (Digest, Aug. 5, Sept. 30), an article in *Indian Engineering* on the question how far it is wise to substitute electricity for steam on long distance railways, is briefly abstracted and discussed. It is pointed out that the electric system can deal with heavier loads and grades than the steam system, and that in India large water power is available, while the price of coal is high.—Lond. *Elec. Rev.*, Nov. 17.

*Surface Contact System.*—A note on a system devised by Parker, which is to be tried on a part of the tramways in Wolverhampton, England. From contact studs slightly above the normal level of the roadway the electricity will be collected by long skates on the car. The studs are connected to the mains mechanically by means of switches placed near the studs and operated by a star wheel in a small slot which is provided in the roadway by using a double rail. The four arms of the star wheel project up into the circuit; at each end of the car a tongue projects down into the conduit, and engages the arm of the star wheel. The connections between star wheel and switches are such that the first movement of the wheel through 90° puts the switch on, while the next movement opens it.—Lond. *Elec. Eng.*, Nov. 17.

*Conduit System.*—WITZ.—An illustrated description of the Bede system which is now being tried on a quarter-mile line in Brussels. A conduit is used and the current is taken off continuously from contacts every 3¼ feet. The insulated cable is protected by iron channels and every 3¼ feet there is a lateral, hermetically sealed box, in which the cable is bared; the side of the box is fitted with an india rubber plug with a contact pin in the middle, which has a conical surface on the outside. The cars are provided with arms of a length of 3½ feet, which when moving forward press against the lateral conical surface of the contact pins, and thereby move them into the box, making contact with the bare cable. The details of the arrangement are described and illustrated.—*L'Eclairage Elec.*, Nov. 11.

*Electromobile Competition.*—Kallmann.—An account of the competitive race of electromobiles, held at the conclusion of the International Motorcar Exposition in Berlin. The batteries of the automobiles exhibited yield an average run of 31 miles with one charge, their weight being about one-third of the total; generally there are 28 lbs. of batteries required per ton mile. Most of the motors were series wound; the expectation is expressed that compound wound motors will finally prove to be the best with main shunt coils for normal running and an additional series coil for starting, etc. The real race began through a street 1300 feet in length with an average grade of 5 per cent., the maximum being 8.1 per cent.; the cars were required to run the first half at maximum speed, the second at "minimum speed;" most of them could not do this; but ran at an average speed, the maximum power consumed being 2.1 watts per lb. of total weight, and the minimum 1.2 watts. Then the automobiles had to run at a speed of 7.4 miles per hour over 5 miles; the best result then was a consumption of 140 watt-hours per mile and a ton of total weight, and 860 watt-hours per mile and ton of live weight; the worst result was 226 and 1610 watt-hours respectively. Then the automobiles had to run at maximum speed over 5.3 miles; the best result was 16 miles per hour, the worst 8.3 miles. Of the eight automobiles which started, only six started for the last portion of the race over 6.6 miles, at a speed of 11 miles per hour, and only four of these ran at that speed.—*Elek. Anz.*, Nov. 9; *Elek. Tech.*, Nov. 15.

*Automobiles.*—An illustrated description of a new type of German electric automobile. The front wheels are driven by enclosed motors, which are illustrated, together with their characteristic curve. The normal power is 2.5-hp at 900 revolutions per minute. The accumulator battery consisting of 44 cells, has a weight of 1320 lbs. and a capacity of 120 ampere-hours. The connections between batteries and motors are illustrated in a diagram.—*Elek. Anz.*, Nov. 9.

REFERENCES.

*Berlin Elevated Railroad.*—A full reprint of the project of the Union Electric Co., to install electric traction on the Berlin Elevated Railroad (Stadt and Ring-Bahn). It is also commented upon editorially.—*Elek. Zeit.*, Nov. 16.

*Batavia.*—Lippegaus.—A long illustrated English abstract of the German article noticed in the Digest Nov. 18.—Lond. *Elec. Eng.*, Nov. 17.

*Bridge Ferry in Rouen.*—A long illustrated abstract of the article noticed in the Digest Oct. 21.—*Sc. Amer. Sup.*, Dec. 2.

## Installations, Systems and Appliances.

*Cost of Central Lighting Plant.*—The first part of an article pointing out that now, when electric lighting is settling down into a steady business, it is possible to arrange the size of the station and the output of the initial generating sets so that they are in proportion to the units that will be required later on. A table for cities of 8 different sizes, the populations being between 20,000 and 160,000, gives what is considered to be the proper size of a first installation together with an estimate of the cost of the various items which go to make up a complete plant. The system of distribution is supposed to be by continuous current on the three-wire system with 440 volts across the outers. For a population of 20,000, 60,000, 100,000, 160,000 the probable number of 8-cp lamps which will be connected before the end of two years, is given at 4500, 12,000, 20,000, 30,000, respectively, and it is assumed that about two-thirds of this number will be lighted at one time. From this the kw of plant required without reserve, are calculated to be 90, 240, 400, 600-kw respectively, while the total kw of plant installed are 135, 360, 600, 900 respectively. It is furthermore assumed that three generating units be laid down, one being regarded as a reserve, and that the buildings be large enough to hold a plant for three times the number of lamps estimated for the first installation. The total cost of the plant is thus found to be $50,000, $84,500, $112,500, $145,000, and the cost per kw installed, $370, $235, $187.5, $161 respectively.—Lond. *Elec., Rev.*, Nov. 17.

*Service Charges.*—Beal.—Two tables giving the cost per kw-year of 365 or 313 days of 8, 9, 10, 12, 15, 18, 21 or 24 hours, for nine different values of the cost of the kw-hour, varying between 1 and 2 cents. Also two tables for the cost per hp-year of 365 or 313 days if the cost of the hp-hour varies between 0.746 and 1.492 cents. Also two tables giving the cost per hp-year of 365 or 313 days for 13 different values of the cost of kw-hour or hp-hour, varying between 0.6702 and 2.6810 and between 0.500 and 2 cents respectively. The tables are calculated without reference to a load factor or of any sliding scale of rates.—*Jour. of El'ty*, October.

REFERENCE.

*Hamburg.*—A long abstract of the annual report of the electric plant of Hamburg, Germany, for 1898-9. The plant furnishes current for incandescent and arc lighting in Hamburg and Altona, and power for motors and tramways.—*Elek. Anz.*, Nov. 5.

## Wires, Wiring and Conduits.

*Determination of the Most Favorable Number of Distributing Points of a Network.*—Sengel.—The first part of a mathematical determination of that number of distributing points or transformer stations of a given network, for which the whole cost of the installation is a minimum. That such a most favorable number exists, is evident from the following: The greater the number of distributing points, the smaller the cross-sections which are necessary for the conduits starting from these points and the lower their cost; on the other hand, the smaller the number of distributing points, the smaller is the cost of leading the power from the generating station to the distributing points and of transforming there. He has calculated some special cases and has found results which agree so well that he believes he is justified in drawing general conclusions. In the present part he calculates the cases of a network formed by squares and that of a network formed by equilateral triangles.—*Elek. Zeit.*, Nov. 16.

*Insulation of Alternating Current Lines.*—Leblanc.—The concluding part of his article on the influence of the capacity upon the insulation (Digest, Nov. 18). He sums up his results as follows: The difficulty of insulation in alternating current circuits is due to the harmonic waves superposed upon to the main wave. The capacity increases the difficulty of insulation, as it tends to cause resonance. In a network of armored cables for a given voltage, either the capacity should be very small so that only very high harmonic waves can resonate, or the capacity should be so great that the first harmonic wave cannot resonate. In alternating current networks it is the closing extra-current which is dangerous, not as with continuous currents in which it is the opening extra-current.—*L'Eclairage Elec.*, Nov. 4.

REFERENCE.

*Circuit-Breakers.*—Baxter.—An illustrated description of different types of magnetically operated circuit breakers.—*Amer. Mach.*, Nov. 30.

## Electro-Physics and Magnetism.

*Contact Electricity.*—Spiers.—An abstract of an English Physical Society paper, giving an account of a series of experiments made to measure the true potential difference between two dissimilar metals in contact; platinum and zinc were first used, then platinum and aluminium. In order to remove the air sheets which cling to the surfaces, the tube was repeatedly heated and exhausted; the potential difference between the plates was found to fall gradually as this was done, which was proved to be due to the oxidation of the aluminium, for on cleaning its surface the original effect was again obtained. As attempts to get rid of the oxygen failed, he substituted iron for aluminium and burned out the oxygen with hydrogen, encasing the lower part of the apparatus in a copper tube and heating to bright redness. By this means the value of the volta effect between iron and platinum in an atmosphere of hydrogen was found at 0.6-volt, the platinum being positive. This result is different both in magnitude and sign, from that obtained when air is the medium. A very extended discussion followed.—Lond. *Elec. Rev., Ind. and Iron*, Nov. 17; *El'ty*, Nov. 29. The paper is commented upon in an editorial note in Lond. *Elec. Rev.*, Nov. 17.

*Ohm's Law.*—Mewes.—A theoretical article in which he deduces Ohm's law from the law of the conservation of energy by applying it to his special vibration theory of the electric phenomena. (It has long been well known that independently of any special hypothesis of the nature of electricity, Ohm's law is nothing but the application of the law of the conservation of energy to a circuit in which the whole electrical energy is changed into Joulian heat. For the electric energy furnished in the time $t$ by any source to a circuit, is $eit$, in which $e$ is the voltage at the terminals and $i$ the current; the Joulian heat is $i^2rt$; hence $eit = i^2rt$ or $e = ir$).—*Elektrochem. Zeit.*, Nov. 1.

*Effects of Torsion on the Resistance of Alloys.*—De Szily.—An account of many experiments made with constantan, an alloy which has a negligible temperature coefficient. He found that the electrical

resistance increases with the angle of torsion. Up to the elastic limit of the metal the variation appears to be directly proportional to the angle of torsion, but beyond this limit the resistance varies more rapidly than the torsion. After being subjected to and maintained in torsion, the resistance very slowly diminishes with time.—*Comptes Rendus,* 128, p. 927; noticed in *Science Abstracts,* November.

*Electrostatic Rotation.*—DELL.—A short illustrated article referring to the experiment described in the Digest last week and stating that he now finds that it is the shape of the pieces of tinfoil and not the differences in their size, which causes the rotation; by changing their shapes the direction of rotation can be reversed. He believes it is the repulsion of the discharges from the sharp points that drives the disc.—*Elec. Rev.,* Nov. 22.

REFERENCES.

*Atmospheric Electricity.*—CHAUVEAU.—A very brief summary of the theories advanced.—Paris, *Soc. Franc. Phys. Bull.,* 133, p. 2, June; noticed in *Science Abstracts,* November.

ODDONE.—A short article in which he points out that the potential increases in ascending, and that it is not the potential, but the potential gradient which diminishes.—*Nuovo Cimento,* 9, p. 448, June; noticed in *Science Abstracts,* November.

PELLAT.—An account of experiments made on the summit of the tower of the Sorbonne (Paris) with an apparatus which follows very rapidly the variations of potential of the air.—Paris, *Soc. Franc. Phys. Bull.,* 134, p. 1, June; noticed in *Science Abstracts,* November.

CHAUVEAU.—An abstract of a paper read before the French Association for the Advancement of Science, giving an account of measurements of the daily variation of atmosphereic electricity, made on the Eiffel Tower.—*L'Eclairage Elec.,* Nov. 11.

*High Frequency Glow Light Phenomena.*—EBERT.—A longer illustrated abstract of the article noticed in the Digest, Nov. 18.—*Elek. Zeit.,* Nov. 16.

*Irreversible Radiation Processes.*—PLANCK.—The fifth and concluding paper of a series of German Academy papers in which he applied the two laws of thermodynamics to the theory of irreversible radiation processes. In this paper he considers a vacuum bounded by completely reflecting surfaces, in which there are electromagnetic waves, and one or more resonators or dipols. The papers are highly theoretical.—*Berlin Akad. Sitzber,* 25, p. 440; abstracted with some of the formulas in *Science Abstracts,* Nov.

*Electro-Photography.*—FOMM.—An illustrated abstract of the article noticed in the Digest Nov. 25.—*Elek. Zeit.,* Nov. 16.

*Cooling Device for Röntgen Tubes.*—BUGNET and CHABAUT.—The short, illustrated French Academy note, abstracted in the Digest, Nov. 25.—*L'Ind. Elec.,* Nov. 10.

*Highest Aim of the Physicist.*—ROWLAND.—The full address delivered before the American Physical Society, which was abstracted in the ELEC. WORLD AND ENG., Nov. 4.—*Am. Jour. of Sc.,* Dec.

*Early Electricity.*—LESNEUR.—An historical article on the development of the science of electricity from Thales to Faraday.—*Appleton's Pop. Sc. Mo.,* December.

*Magneto-Optics.*—GRAY.—The first part of an illustrated paper of general nature read before the Royal Institution, on magneto-optic rotation and its explanation by a gyrostatic system.—*Sc. Amer. Sup.,* Dec. 2.

*Movements in the Magnetic Field.*—ZENGER.—An abstract of a paper read before the French Association for the Advancement of Science, giving an account of experiments made with a gyrostat moving rapidly in a strong magnetic field, and applications to the theory of planetary motion.—*L'Eclairage Elec.,* Nov. 11.

*Vibrations of Charged Ions in a Magnetic Field.*—LORENTZ.—*A* mathematical paper in which the presence of a number of rays is predicted by a certain hypothesis and their frequencies and intensities calculated.—(See also the abstract on magnetism and molecular rotation by Lord Kelvin, Digest, Aug. 26.)—*Archives Neerlandaises,* 2, 5, p. 412; briefly noticed in *Science Abstracts,* Nov.

## ELECTRO-CHEMISTRY AND BATTERIES.

*Charging and Discharging Accumulator Batteries.*—A description of a method to prevent a battery from being charged or discharged too far, which is accomplished by utilizing the property of aluminium to give as an anode a high e. m. f. of polarization, about 20 volts in an acid solution and 100 volts in an alkaline solution, the polarization being nearly instantaneous (see the abstract on aluminium anodes for converting alternating current into continuous current, Digest, Oct. 7). The polarization may, however, be delayed in such a cell by adding a certain quantity of a depolarizer, for instance, protosulphate of iron; then the current goes through the cell until all ferrous oxide is changed into ferric oxide, and when this has taken place, the polarization e. m. f. of the aluminium anode appears. Hence, if an aluminium electrode is enclosed in a porous cup containing a solution of sulphate of peroxide of iron and a number of ampere hours is sent through the cell with the aluminium as cathode, so that a certain quantity of ferric oxide is changed into ferrous oxide, the same number of ampere hours must be sent through the cell in a reverse direction until the polarization appears. Instead of such an oxydizing material, a solution of a metal may be used as the electrolyte of the cell, for instance, sulphate of copper; then copper is deposited on the aluminium cathode, and if the current is sent through the cell in the reverse direction, the polarization e. m. f. of the aluminium anode does not appear, until all the copper has gone back into the solution. The application of this phenomenon to the discharge of an accumulator battery is simple; it is only necessary to connect a cell having an aluminium cathode with the accumulator battery during the charge, then, if the battery is discharged, the polarization of the aluminium, which is now anode, appears as soon as the battery has given out the same number of ampere hours which it had received during the charge. If the e. m. f. of the battery is high, several aluminium cells in series may be used. In order to prevent too high a charge of the battery, the cell must have the aluminium as anode during the charge; in this case only one cell is generally sufficient, as the e. m. f. of polarization has to overcome only the difference of the e. m. f.'s of battery and charging machine.—*Elek. Rundsch.* 16; abstracted in *Elektrochem. Zeit.,* Nov.

*Accumulator Batteries.*—Three communications giving rules to be observed in charging batteries. A good charging current is said to be one ampere to every 100 sq. inch of submerged lead plate, counting both sides of every plate, gray or brown. From a Brit. Ass'n paper of Cahen and Donaldson it is quoted that when a cell is charged at constant potential, the time of charging is less than half of that required at constant current, the capacity is also 30 per cent. greater, but the energy efficiency is 10 per cent. less. Hence for central station work it should be advisable to try and arrange to charge at constant current, while for motor car batteries it would be better to charge at constant potential.—Lond. *Elec. Eng.,* Nov. 17.

*Zinc Plating.*—A set of rules which it is claimed should be carefully followed. First, the object which is to be plated must be freed carefully from all grease, then suspended in a solution of caustic soda, containing 1 lb. per 1.2 gallon, at a temperature a little below 212 degrees F.; when taken out, it must show a uniformly wetted surface. It is then washed in a solution which has to be different for different cases, but in general, a saturated solution of hydrate of lime is sufficient; the object must be kept in the washing tank for some time, over night if possible. The specific gravity of the electrolytic solution should be 1.135; there should be about 1.9 lbs. of sulphate of zinc per gallon. The current density should be between 0.1 and 0.2 ampere per sq. inch. This bath becomes exhausted and must be regenerated in a separate tank. A sieve in this regenerating tank is covered with cocoanut fibre, over which is a six-inch layer of coke granules about the size of hazel nuts, over this a four-inch layer of pieces of coke the size of peas, over this the zinc dust mixed with double its weight of coke dust. The mixing tank for producing the sulphate of zinc is formed of glazed pottery ware or is lined with lead; it is filled two-thirds with dilute sulphuric acid containing one part of acid to ten parts of water. Zinc dust is added and is kept in circulation until the solution of sulphate of zinc becomes neutral.—From *Tech. Rund.,* abstracted in *Elektrochem. Zeit.,* Nov.

*Electrodeposition of Brass.*—BAKER and BAKER, JR.—The precipitate produced by adding cyanide of potassium to a cold solution of sulphate of copper, is regarded as cupric cyanide, which on boiling passes into cuprous cyanide by losing cyanogen. Both compounds are soluble in cyanide of potassium, and these solutions are used for the electrodeposition of copper and brass. The brass solutions deposit more metal than a copper sulphate bath, placed in series with them.—*Chem. News,* July 28; noticed in *Science Abstracts,* Nov.

REFERENCE.

*Metallic Deposits on Non-Conductors.*—A description of the two methods which are used in practice to increase the conductivity of poor or non-conductors, one based on treatment with plumbago and the other with a solution of silver.—*Elek. Tech.,* Oct. 31.

### UNITS, MEASUREMENTS AND INSTRUMENTS.

*Photometry of Arc Lamps.*—An illustrated description of the apparatus used in the Paris Central Laboratory, for finding the distribution of light of arc lamps in a vertical plane. The arc lamp and photometer are fixed and the inclination of the mirror to the reflected ray is constant. The arc lamp is so suspended that the arc is in the centre of a vertical circle, along the periphery of which the mirror can be moved. The mirror is set so that the reflected rays always fall upon the centre of the photometer which is horizontal and perpendicular to the plane of the vertical circle. The results of the measurement of Laporte with and without globe and reflector (Digest, Sept. 16.) are given.—*Zeit. fuer Beleucht.,* Nov. 10.

*O'Keenan Meter.*—A short description of an ampere hour meter consisting in principle of a small motor connected as a shunt to a fixed resistance, so that the e. m. f. of the motor, and consequently its angular speed, is proportional to the voltage between the terminals of the fixed resistance, and, therefore, to the current to be measured. Around a fixed cylinder of soft iron the two pole pieces of a permanent magnet are arranged. Within the annular air-gap revolves an armature, consisting of a non-conductive support bearing coils connected to a collector and brushes. A watt-hour meter has been constructed as follows. The magnetic field is produced by a permanent magnet, and an electromagnet placed opposite, which is not saturated and is excited by a shunt across the terminals of the total difference of potential. The two magnetic fluxes produced are in the same direction; by giving them the same value, a counter e. m. f. is obtained proportional to the flux which diminishes as the difference of potential increases. This watt-hour meter is exact as long as the variations of voltage are slight. These instruments are said to have been tried for some time, and to have given very satisfactory results.—Lond. *Elec. Rev.,* Nov. 17.

#### REFERENCES.

*Instrument for Plotting the Wave Form of Alternating Currents.*—FRANKE.—A paper read before the Union of German Electrical Engineers, describing an instrument for automatically plotting the wave form of any periodic process, the principle being that of Joubert to make instantaneous closures of the circuit at various phases by means of a momentary contact. His improvements of Joubert's method are described in detail, and some of the curves plotted by his instrument are reproduced.—*Elek. Zeit.,* Nov. 16.

*Measuring the Angle of Phase.*—ARNO.—A short illustrated description of his method of measuring the angle of phase (see Digest, Nov. 4).—*L'Elettricista,* Sept. 1; abstracted in *L'Eclairage Elec.,* Nov. 11.

*Three-Phase Energy Meter.*—An illustrated description of a recently patented meter of Siemens & Halske, which is of the induction motor type.—*Elek. Rund.* 16, p. 152; noticed with illustration in *Science Abstracts,* Nov.

### TELEGRAPHY, TELEPHONY AND SIGNALS.

*Telegraphy and Leakage Currents.*—LODGE.—An editorial note concerning his communication to the London *Times* in which he suggests telegraphing from the besieged town of Ladysmith by leakage currents. A wire running east and west through the town is to be earthed at the two ends and another parallel to it as long and as near to it as possible, outside of the town, and earthed at each end; each circuit contains an alternator and a signaling switch for sending, and a telephone and condenser for receiving. Editorially the practicability is questioned as the nearest point for the outside line would be 30 miles distant, which is probably too far if a battery and reversing switch had to be used, as would be likely, instead of an alternator.—Lond. *Lightning,* Nov. 16; the communication is reprinted in the Lond. *Elec. Eng.,* Nov. 17, and *El'ty,* Nov. 29.

*Pacific Cable.*—A brief account of Bradford's report to the Secretary of the Navy, on the recent surveys from Honolulu to the Philippines. After careful consideration it was decided that the best route was by way of the Midway Islands and Guam, landing on the east coast of Luzon. A route was also surveyed from Guam to Yokohama. Two offsets from the great circle route between the Midway Islands and Guam were found necessary, one being a submarine mountain and the other the deepest submarine abyss yet found in the world, about 500 miles east of Guam, the depth being more than 4500 fathoms.—*West. Elec.,* Nov. 25.

*Motor Generators vs. Gravity Cells.*—A short article on the simplicity of an electrically driven dynamo over one driven by belting, and on the advantages in cost, space and cleanliness over chemical batteries for telegraph lines and other work. The smallest size of motor generator, occupying a space of about eight inches cube and giving an output of 1-12-hp at an annual expense of $150, displaces about 800 cells of bluestone battery, occupying a space of about 10 feet cube and requiring a cost of maintenance of $800 per year.—*Jour. of El'ty,* Oct.

#### REFERENCES.

*Central Energy Systems.*—DOBBS.—An article pointing out that central energy systems, in which all batteries, both for signaling and speaking, are located in the central office, have not been an unqualified success. The advantages claimed for them are discussed in detail and objections are made, which, however, he believes, may be overcome in the future.—*West. Elec.,* Nov. 25.

*Party Line System.*—WEST.—An illustrated French abstract of the German article noticed in the Digest, Feb. 4.—*L'Eclairage Elec.,* Nov. 11; briefly abstracted also in *Science Abstracts,* Nov.

*Progress in Telegraphy and Telephony.*—An account of the progress made from July to September. Besides the development in wireless telegraphy which was duly referred to in the Digest, some new inventions in ordinary telegraphy and telephony are noticed, the descriptions being taken from patent specifications. There is now a tendency to use aluminium wire instead of copper; the General Electric Company of Berlin, more especially, is working in this direction. —*Elek. Anz.,* Nov. 12.

*Speed Regulator for Printing Telegraphs.*—An illustrated description of the regulator of Siemens & Halske, which has been recently adopted in the Italian telegraph service.—*L'Elettricista,* Sept. 1; an illustrated French abstract in *L'Eclairage Elec.,* Nov. 11.

*Cable Steamer.*—A description of the first German cable steamer which was recently built to lay and repair cables for the German Post Office Department in the seas adjoining Germany.—*Elek. Anz.,* Nov. 16.

### MISCELLANEOUS.

*Electrical Welding.*—HEFTER.—A long illustrated paper read before the Association of Electrical Engineers in Luettich, stating that extended use is made of electric welding in Russia, especially in the repair shops of the government railways. The Benardos and the Slawianoff methods are used. In both, the piece of metal to be operated upon is connected with one pole, while for the other pole a carbon rod is used by Benardos and a piece of the metal by Slawianoff. In the Benardos process thin pieces of metal are laid on the part to be acted upon, and are melted by the arc with the carbon rod, and after a layer of metal has thus been formed, it is forged; this is repeated as often as necessary. In the Slawianoff process the end of the metal rod forming one pole is itself melted off and drops into the hole to be filled, the arc being adjusted by an automatic regulating device. Special applications for different purposes are described and illustrated. In the conclusion the two methods are compared, and that of Slawianoff is said to be preferred in general, as the heat generated is considerably less, so that its use for different metals is more extended; moreover, the welds are more homogeneous.. The Benardos method requires a more careful workman and an accumulator battery is necessary for saving the machine, on account of the large variations of the current, while in the method of Slawianoff these variations are prevented by the automatic adjustment of the arc. The burning of the parts surrounding the place to be welded, which often occurs in the Benardos method, on account of the traveling of the arc, cannot occur in that of Slawianoff, as the arc follows the fused drops. A piece of metal welded by the Benardos method must always be forged afterwards, while this is not essential in the Slawianoff method.—*Bull. de l'Ass. des. Ing. Elec.,* Liege, 17, 246-286; a long illustrated German abstract in *Zeit fuer Elektrochemie,* Nov. 16.

*Electricity and Animal Growth.*—A note stating that Herdman found that by treating animals by electricity under certain conditions, the growth could be increased at the rate of 18 to 24 per cent. per week (similar experiments were described in the Digest, Aug. 4, 1894, and April 13, 1895). The treatment consisted in placing the animals in a cage through which an alternating current passed for six hours each day. He also found that a stronger and more lasting current produces depressing effects which retards the growth.—*West. Elec.,* Nov. 25.

*Dark-Lightning.*—WOOD.—An illustrated article on the effect observed by Clayden. If a plate which has received an impression of a lightning flash or electric spark, is subsequently slightly fogged, either by exposing it to feeble diffused light or by leaving the lens of the camera open, the flash on development comes out darker than the background in the positive print; if, however, the plate was

fogged before the image of the flash was impressed, it came out brighter than the background, as in the ordinary pictures of lightning; this is the Claydon effect. It cannot be obtained by impressing an image of a filament of an incandescent lamp on a plate and subsequently fogging the plate; there is something about the light of the spark which is essential to the production of the reversal. He describes a number of experiments which show that the duration of the illumination is the important factor. The action of an intense light on a plate for a very brief time intervally decreases the sensitiveness of the plate to light.—*Science,* Nov. 17.

*Velvril as a Substitute for Gutta-Percha.*—REID.—An editorial abstract of a paper read before the Society of Chemical Industry on the use of "velvril," which is a combination of nitrated linseed or castor oil with nitro-cellulose. It is suitable for belting, waterproofing cloth, varnish, etc., but has not the same mechanical properties as gutta-percha. It lacks the strength and elasticity required for a golf ball, as well as the flexibility necessary for the core of a submarine cable, and has an objectionable odor. No data were given of its electric properties.—Lond. *Elec.,* Nov. 10.

REFERENCES.

*Electric Welding and Soldering.*—ENZLER.—Continuations and the conclusion of the paper noticed in the Digest Nov. 11. The researches of Branwell, Thomson, Fish, Kennedy, Boston Electric Forging Company, and Kirkaldy are discussed. For different materials the power consumed per unit of surface is given in three tables; another table gives the strength of electrical welds. The electric copper wire welder of Lemp and several methods of welding rails, pipes, etc., electrically are described and the application for cast iron, wrought iron, steel iron, steel, copper, brass, lead, zinc, tin, aluminium and nickel for these purposes, and the use of fluxes are briefly discussed. The method of electric heating, devised by Lagrange and Hoho, is also described.—*Elek. Anz.,* Oct. 29, Nov. 2, 5.

*Electric Welding.*—LEMP.—An illustrated German translation of an article which appeared some time ago in which several American processes are described.—*Elektrochem. Zeit.,* Nov.

*Magnetic Separators.*—MCNEILL.—The first part of a long, illustrated abstract of the paper noticed in the Digest Sept. 23.—*Eng. & Min. Jour.,* Nov. 18.

*Electrolytic Method of Sharpening Files.*—COWPER-COLES.—A reprint of the short article noticed in the Digest Nov. 25.—*El'ty,* Nov. 22.

*Early Electricity.*—DE FODOR.—A long historical article on electricity before the time of Volta.—*Zeit. fuer Elek.,* Nov. 5.

## New Books.

LA TELEGRAPHIE SANS FILS. By Andre Broca. Paris: Gauthier-Villars, Imprimeur-Libraire. 202 pages, 34 illustrations. Price, 3 fr., 50c.

The object of this volume is to give a complete review and present to the reader the status quo of the art of signaling by means of electricity without the use of a conducting system in the formerly accepted sense of the word.

The book commences with a brief outline of the plan of the work, and then takes up in detail the various methods of telegraphing and signaling which have formerly been in vogue, whereby conducting systems, in the form of wire or cable, have been employed. To the electrical reader this part of the work seems slightly overdrawn, as it is purely historic and of little value even as an introduction In chapters two and three the author discusses the phenomenon of alternating and pulsating electrical effects, giving the at present accepted ideas as to the successive changes which take place with varying electrical conditions. In chapters four and five the propagation of electrical undulations and the Hertz phenomenon are discussed. In chapters six and seven receivers and transmitters are explained and illustrated, while the balance of the volume is devoted to a mathematical discussion of the laws (so far as they are known) of the electrical undulations in the ether.

The book is carefully and conscientiously written in as simple a manner as it is possible to treat so complicated a subject, and will be found of value to all those who are interested in the study of this department of electricity.

BOOKS RECEIVED.

LECONS SUR L'ELECTRICITE. By Eric Gerard. Tome Second. Applications de l'electricité à la Téléphone, à la production et à la transmission de la puissance motrice, à la traction, à l'Eclairage, à la Métallurgie et à la Chimie Industrielle. Paris: Gauthier-Villars et Fils, Editeurs. 790 pages, 387 illustrations. Price, 12 fr.

KINEMATICS OF MACHINERY. A Brief Treatise on Constrained Motions of Machine Elements. By John H. Barr. New York: John Wiley & Sons. 8vo. 247 pages, 213 illustrations. Price, cloth, $2.50.

## Electric Victoria of the U. S. Automobile Company.

For some time past Mr. Frank Mossberg, President of the United States Automobile Company, Attleboro, Mass., has been working on the subject of automobiles, bringing to bear no small amount of practical ingenuity and mechanical experience. We are now enabled through his courtesy to illustrate and describe his new and latest model, in the electric victoria shown herewith, Fig. 1. This carriage weighs complete only about 2200 pounds.

FIG. 1.—ELECTRIC VICTORIA.

It is capable of going from 25 to 30 miles on one charge on good streets, and this is regarded by the builder as a sufficiently wide radius. The battery is mounted on independent springs fastened to the truck, the carriage proper being mounted on ordinary light carriage springs. It thus rides very easily, a feature that will always be appreciated by the occupants of such vehicles. The driver has his bench quite low down, with the object of giving the passengers an unobstructed view. The controller is of simple design and furnishes three forward speeds and two backward. The forward rates of speed are 3, 6 and 12 miles.

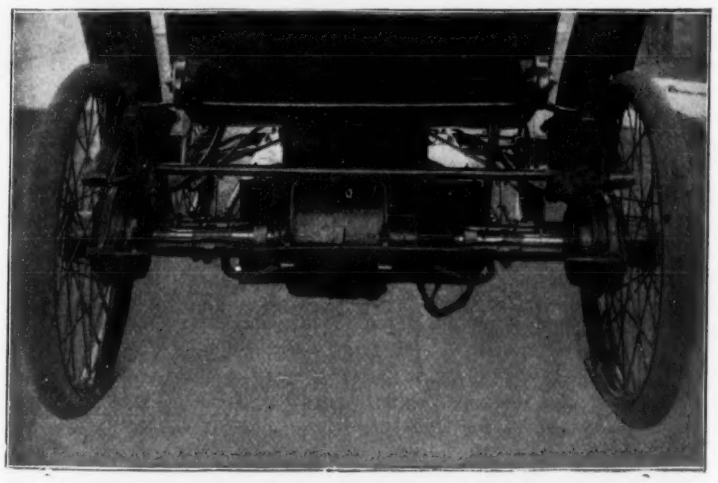


FIG. 2.—REAR VIEW OF ELECTRIC VICTORIA.

The rear of the carriage is shown in Fig. 2, which also exhibits clearly the motor mounted in the center of the rear shaft. This motor is of special design, and is one in which both the field and the armature revolve. One driving wheel is connected to the field and the other to the armature by means of reduction gears, and no compensating gear is necessary in this construction, as the motion of the field and armature gives all the flexibility required. Although developing easily 3-hp, this motor weighs only 125 pounds. Its various features of novelty have been fully patented.

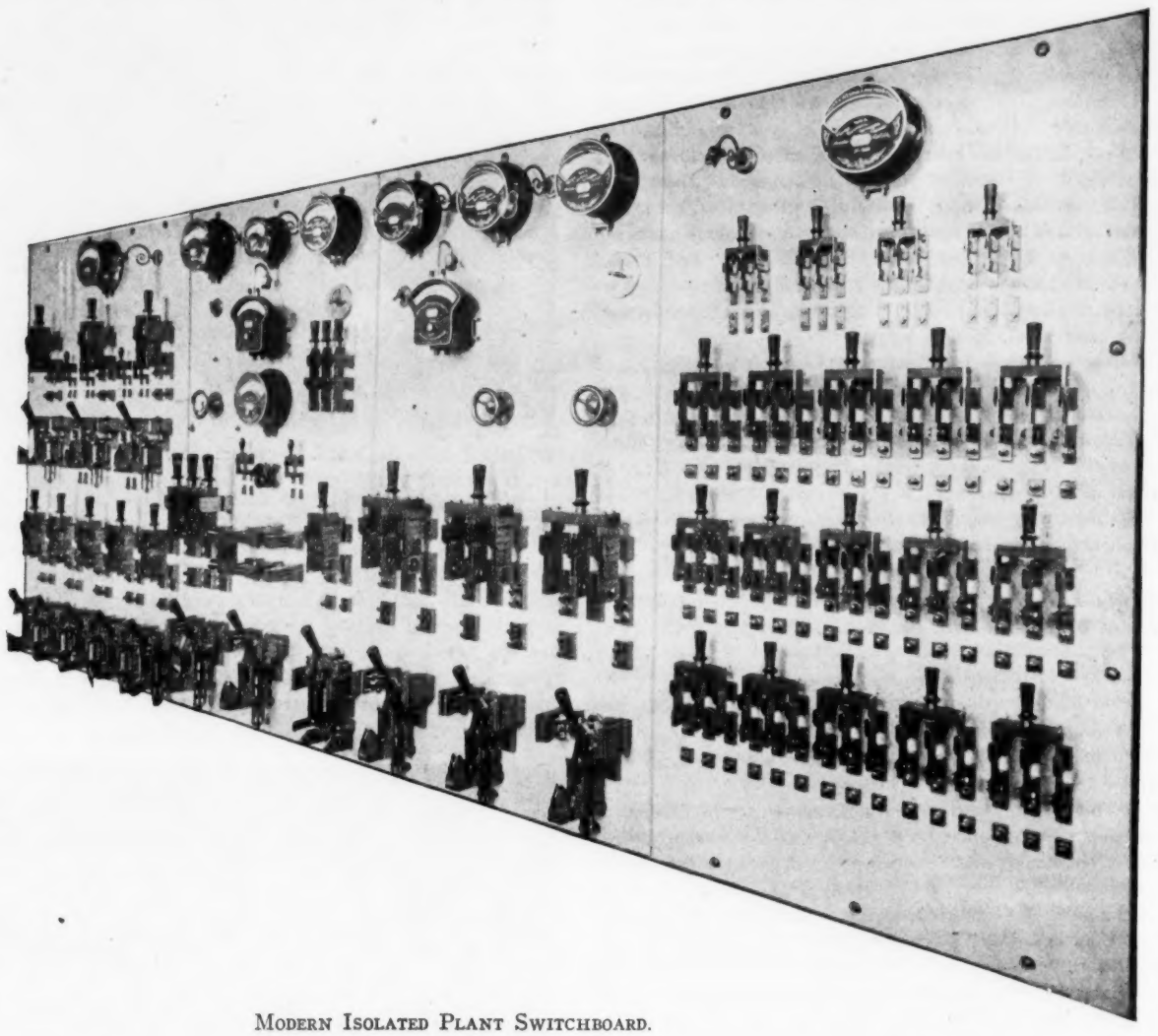
The United States Automobile Company inform us that they have now in course of construction several different types of carriages and that they contemplate installing a public hack system in Providence and other cities in the state of Rhode Island, where it is said they have an exclusive charter to operate motor vehicles for public service.

## Switchboard in German-American Insurance Building, New York.

The General Incandescent Arc Light Company has recently installed in the engine room of the German-American Insurance Company Building, Liberty and Nassau Streets, New York City, a new switchboard, built after plans and specifications of Mr. C. O. Mailloux, electrical engineer. This board may be regarded in many ways as a model type of modern isolated plant switchboard construction. The board proper is made of a fine grade of Tennessee marble, arranged in four panels or sections. The generator panel contains all the apparatus for the control of three 100-kw direct-current dynamos, including main and equalizer switches, circuit breakers, field rheostats, ammeters, voltmeters and differential galvanometers, the two latter connected to radial voltmeters and ground detector switches for the purpose of securing and measuring balanced conditions for throwing in and out any of the generators. The galvanometer is also connected, so that ground leakage readings may be taken on any of the feeders to or from the board at any time.

The battery panel contains all the apparatus and devices for the operation of the storage battery equipment and its accompanying motordynamo booster, the former having a capacity of 2000 ampere-hours. The appliances on this panel consist of the various switches for charging and discharging the battery and for the booster motor and booster dynamo, with the necessary safety devices, together with ammeters, voltmeters, voltmeter switches, and cell indicators, etc., the whole arranged in a uniform and systematic manner for the safe and economical operation of the battery.

The two feeder panels serve for the supply and control of the various feeders, all of the lighting switches being arranged on the right-hand end panel, and the various power switches at the left-hand end panel. All the lighting feeders are controlled by three-wire switches, each provided with safety fuses on the face of the board. Th power feeders are controlled by two-wire switches and single-pole circuit breakers, for the various passenger and freight elevators and ventilating motors. All the busbar connections are made at the back of the board of pure drawn copper and are arranged in the most substantial and systematic manner, all of the heavy buses being thoroughly laminated. The connections from the busbars to the various switches and appliances are made by flat drawn copper, the joints for these being made between the laminations and held fast by means of through bolts, thus securing perfect contact conditions. All the various shunt and voltmeter connections on the back of the board are wired through hard rubber tubing and held fast to the back of the board in a secure manner, so that no loose or tangling connections appear, thus presenting an unusually neat and safe appearance on the back of the board.



MODERN ISOLATED PLANT SWITCHBOARD.

Not the least interesting part of this equipment was the manner in which it was installed. The new board was erected in place of an old board, during the two days of the Dewey celebration, and the entire change from the taking down of the old board to the erection of the new one was made during that period without a moment's interruption of the service in the building, in either the lights or the passenger elevators. A temporary skeleton switchboard was constructed and placed in the engine room and temporary connections were made to the dynamos and feeders, one at a time. During the two nights of the celebration all the lights in the building were turned on for the purpose of illumination, and during one day the passenger elevators for the purpose of taking visitors to the roof of the building to view the naval parade. These conditions necessarily taxed the service to its full capacity, and no little credit is due to the manufacturers for the efficient manner in which this service was kept up uninterruptedly during the installation of the new board.

## The Standard Automatic Gas Engine.

The Standard Automatic Gas Engine Company, of Oil City, Pa., is placing on the market a new type of gas engine, designed by its president, Mr. J. W. Raymond, who is well known as the designer of the Raymond engine, made by the J. I. Case Threshing Machine Company. Though operating on the familiar four-stroke cycle, the engine contains some radical departures from the features associated with this type.

First among these are the valve and valve gear. There is only one valve for both admission and exhaust, and this has the form of a hollow cylinder of cast-iron, chilled and ground. The interior of the valve is open to the engine cylinder, and as the valve turns in the valve chest an opening in it alternately connects the cylinder with an admission and an exhaust port. The valve does not oscillate or have a reciprocating motion of any kind, but simply rolls continuously around in one direction, being turned by a horizontal shaft, driven by nitre gears from the main shaft, and turning the valve stem by 2 to 1 spur gears. The absence of poppet valves, cams, springs, and so forth, makes the engine remarkably noiseless.

The ignition is electrical in character, accomplishing by a wiping spark between side tool-steel electrodes. The moving contact simply rotates with the valve, and the stationary contact is held by springs outside the valve chest and adjustable while the engine is in operation.

The company has recently completed an engine with two 18-inch x 18-inch double-acting cylinders, tandem on one piston rod, with outside crosshead of standard steam engine construction. The two double-acting cylinders give two forward impulses per revolution simultaneous with the compression strokes in the other end of the cylinders. The heavy compression both ways gives very smooth running, even with considerable slack in the crosshead and crank-pin boxes. The piston rod of this engine, owing to the heavy strains it is called upon to bear, is made of nickel steel, drawn with the hole for the cooling water in it. The water in this case is introduced through the crosshead and discharged through the tail rod.

The pistons are cored out and the water passing through the rod is compelled to circulate also inside the pistons, thus cooling them. One horizontal shaft runs along beside the cylinders and turns the four valves of this engine (one for each end of each cylinder) through two pairs of cut gears. The governor actuates one butterfly valve, which throttles the mixture to all four cylinder ends. The course of the mixture to any one, two or three of the four cylinder ends may be cut off to increase the compression and economy at low loads. Indeed, any valve chest may be opened and the igniter taken out while the engine is running. This engine is started by turning it over to the proper point and igniting electrically a charge of very slow burning powder in an enclosure connected with one cylinder head. The connection is made through a number of right-angle bends made in capped tees in such a way that the ash from the powder blows past the bends and is caught in the caps, from which



STANDARD AUTOMATIC GAS ENGINE.

The governing of this engine is not accomplished by the "hit-and-miss" method, but by varying the quantity of the charge by throttling. The mixture is throttled by a plain balanced butterfly valve, as simple as the damper in a stovepipe and almost entirely free from friction, since all points except the stem are out of contact with the walls of the valve chamber except when the valve is shut tight. For this reason the force, which the governor must apply, and the amount of its motion is much less than required for piston or other forms of valves. The proportions of the mixture are determined by entirely independent valves in the incoming air and gas pipes, the constituents being pulled through these and the mixture being pulled through the governing valve by the suction of the filling stroke.

The engine is horizontal and in small sizes, 15-hp and upward, is of the ordinary single-acting form, with a trunk piston acting as a crosshead. In sizes of 50-hp and up, the engine is made with two single-acting cylinders tandem on the same piston rod. The cycles of the two cylinders are displaced one revolution from each other, so that one impulse per revolution is obtained, the expansion stroke in one cylinder occurring immediately before the compression stroke in the other.

The piston rod is extended out through the head of this cylinder in the form of a tail rod, and is made hollow. A long pipe enters into the hollow rod and is packed at the tail-rod end. Cooling water is injected through this long pipe clear into the rod in the second cylinder and flows back inside the rod, but outside the pipe, to a drip at the tail-rod end. The piston rod is packed with non-inflammable packing where it comes through the cylinder head.

it may be removed from time to time. The engine may also be piped to a compressed air tank or steam supply for starting.

This engine is shown in the accompanying illustration, is set up and belted to a 150-kw Westinghouse generator for the Oil City Street Railway. A duplicate is under way for the same purpose, and two of 500-hp each are under order.

The engines are rated on the basis of mean effective pressure, the one shown in the illustration being conservatively rated at 200-hp on the basis of a mean effective of 32 pounds per square inch, although much higher mean pressures may be obtained. Indeed, this engine is guaranteed to develop 300 brake hp with a consumption of not more than 3000 cubic feet of natural gas per hour, this gas showing about 990 B. T. U. per cubic foot.

An interesting equipment of engines for which the company has closed a contract will consist of four like that shown in the illustration, which are ordered for use in Germany. These will be made into two engines by coupling two of them together with cranks at quarters, each complete engine thus consisting of two pairs of tandem double-acting cylinders giving four impulses per revolution. Each such engine will be direct coupled to a three-phase 60-cycle alternator mounted between the cranks, and these alternators will be run in parallel and with rotary converters. Another order is for two engines of 350-hp each, to carry a street railway load in Western Pennsylvania. These engines will get their gas from by-product coke ovens, a gas which is at present thrown away, and requires no elaborate preparation such as washing or scrubbing to adapt it for use in the engines. All it needs is to be passed through holders in which it can deposit its tar.

# NEWS OF THE WEEK.

## Financial Intelligence.

THE WEEK IN WALL STREET saw in general very little change in prices, but nearly all were in the nature of gains, the market at the end of the week closing firm but dull. Two events of an electrical character dominated the situation in New York and Boston, outside steam railroad deals, namely, the big electrical order given by the Manhattan Elevated and the announcement that the American Bell Telephone Company is to merge into the American (long distance) and remove to New York, as already predicted in this column. During the week 2120 shares of Western Union changed hands, easing off ¼ to 87¾. General Electric at its high figure was steady, and on 8460 shares closed at 129½. On sales of 82,195 shares Manhattan Elevated went up 1⅝ to 105⅝, while little was done in Metropolitan Street Railway, which on sales of 9475 shares closed at 193. Third Avenue Railway, now a full-fledged electrical institution, closed at 152. In Boston, American Bell Telephone, on news of the deal, slid down quickly to 347, but rallied to 351; Erie Telephone was 108-109; Michigan, 107; New England, 144; Mexican, 3¼; Massachusetts Electric Railways, preferred, 78; West End, 93½; preferred, 117¼. In Chicago, National Carbon common closed at 18-18¼; Chicago City Railway, 286; Union Traction common, 33½-34; Metropolitan Elevated preferred, 80½-81; Lake Street Elevated, 16¾. In Philadelphia, Electric Storage Battery was quoted at 118-118½ common, 118-119 preferred; Union Traction, 41¾; Philadelphia Traction, 96¾; Penn. Elec. Vehicle Co., 9-9¼ common, 4-4⅛ preferred; American Railways, 6¼-6½; Consol. Traction, New Jersey, 63½. In the New York outside market there were few changes. Electric Axle Light & Power Company was quoted at 6-6½; Electric Vehicle, 70-75 common, 95 preferred; New York Electric Vehicle Transportation, 13-13½; New England, 7-7½; Illinois, 7-7½; Electric Boat, 20-22 common, 40-42 preferred; General Carriage, 60; National Gramophone, 74-77; Otis Elevator, 20-28 common, 92-94 preferred.

SALE OF CHICAGO ROADS.—The Chicago Union Traction Company's purchase of the Yerkes interests in the suburban lines composing the Chicago Consolidated Traction Company, of which Mr. Yerkes owned about $10,000,000, will be followed in a very short time, it is said, by the purchase of the Yerkes interests in the Suburban Railroad Company. Negotiations are already under way, but terms will not be arranged until after the purchase of the Consolidated Company's lines has been completed and the cash has been paid over. The Suburban Railroad Company operates thirty miles of track west of the city limits, and serves as a feeder to the Metropolitan and Lake Street Elevated Railroads. For this reason its acquisition has not been considered so important by the Union Traction Company people as the acquisition of the Consolidated Company's lines, which are direct feeders to the North and West Side surface lines, owned by the Union Traction Company itself. The capital stock of the Suburban road is $1,250,000, and there are 5 per cent. gold bonds to the same amount outstanding. When this purchase has been made Mr. Yerkes will have disposed of the last particle of his interests in surface roads in Chicago, with the exception of his stock in the Union Traction Company itself.

NORTH AMERICAN stock has recently witnessed a considerable rise, due to two causes, the first and most important of which is the extension of the street railway and electric light franchises of the Milwaukee Street Railway Company, which is controlled by the North American Company. In return for these extensions the company agrees to grant four-cent fares during the morning and evening rush hours for a term of years, after which the regular fare will be four cents. It is also understood as the second reason that the long-contemplated readjustment of the securities of the company will soon be consummated. The plan proposed is for the scaling down of the present capital of $40,000,000 of one class of stock to $10,000,000 4 per cent. preferred and $10,000,000 common stock. At the present rate of income from the Cincinnati Edison Company and the Milwaukee street railway, both of which are controlled by the North American, regular 4 per cent. dividends can be paid on such an issue of preferred stock.

CONSOLIDATION IN CONNECTICUT.—Formal announcement is made of the organization under a charter granted by the last State Legislature of a new illuminating company with a capital of $200,000. It will be managed by officers of existing illuminating companies at New Haven and Bridgeport, and will take in the properties of the New Haven Electric Light Company and of the lighting companies at Bridgeport, Stratford and West Haven. It is also negotiating for the property of the New Haven Gas Light Company, which has a capitalized market value of several million dollars. The capital of the organization will be increased as new properties are absorbed.

COMBINATION AT WORCESTER, MASS.—It is rumored in Worcester that a syndicate headed by Lee, Higginson & Co., United States Trust Company and J. I. Blair & Son, New York, has secured an option on the Consolidated Street Railway Company, of that city, and has made an offer for the Worcester Electric Light Company with the purpose of consolidating the two companies. Officials of the street railway company deny the rumor, although an offer of $250 per share was made at a meeting of the Worcester Electric Light Company directors on November 29 by a New York syndicate.

METROPOLITAN.—The steady growth of traffic on the New York Metropolitan lines is evidence that the better the facilities furnished to the public for travel, the greater the use that will be made of them. In October, 1899, for instance, the Metropolitan Street Railway Company carried over 3,000,000 more passengers than in the same month of last year. The gross receipts for October, 1899, were $1,301,726, which was an increase of $50,019 over September, 1898.

COMMERCIAL CABLE.—The Commercial Cable Company, of New York city has filed with the Secretary of State a certificate of increase of capital stock from $10,000,000 to $15,000,000. The stock as increased consists of 150,000 shares of the par value of $100 each. The increase was ordered by the affirmative vote of the holders of 74,982 shares of stock. The certificate, which is signed by George G. Ward and Albert Beck, declares that the liabilities of the corporation are $18,324,949.

QUINCY (MASS.) RAILWAY.—At a special stockholders' meeting of the Quincy & Boston Street Railway Company it was voted to authorize the directors to petition the railroad commissioners for an issue of $317,000 stock, to be used as follows: $230,000 for funding floating debt and $87,000 for double tracking and relaying of rails. With new issue of stock the capital of the company will be $900,000.

BOSTON ELEVATED.—The annual report shows a net of $2,844,290 on gross $9,671,440, and after all charges had been met, dividends of $262,500 had been paid on $5,000,000 stock. The number of revenue passengers carried was 191,000,000, or 10,000,000 more than in 1897-8.

ELECTRIC LIGHT BONDS for the city of Collinwood, O., for 15 years, for $18,000, have been awarded to Holzman & Co., Boston, at 101.0.35.

## Commercial Intelligence.

THE WEEK IN TRADE.—An event standing quite by itself is the order given last week to the Westinghouse Electric & Manufacturing Company by the Manhattan Elevated for generating and distributing apparatus amounting to about $1,500,000, but not including either the motors or the cables, which again will require a large part of the $18,000,000 recently raised for the electrical renovation of the system. Even if regarded alone, the order would give a good idea of the bulk of electrical business, but, after all, it is only part of an enormous development now going on, and which in New York alone at this moment calls for the early expenditure of millions, which will flow through all the channels of electrical industry. It is such conditions as these that explain the general cheerfulness over the electrical situation, which was never better. There is a more equable activity than previously, and development is being successfully pushed in half a dozen directions at once, with new export trade rounding out everything. It is interesting to note that finance and trade are in good shape throughout the country, with less splurge and boom, but with a steady demand for products. Business failures number 171 for the week, as compared with 202 last week, 212 in this week a year ago, 250 in 1897, 359 in 1896 and 315 in 1895. Business failures for November show a notable falling off, says Bradstreet's from those of October, or from those of November in any preceding year for five years past. Liabilities, however, owing to the occurrence of a few large embarrassments not in any way significant of general business conditions, are nearly double what they were in October, but still considerably below those of November a year ago, and make even more favorable comparisons with the same month of preceding years. Relatively the best showing, as regards comparison with November a year ago, is made by the Southern States, failures in which are 40 per cent. smaller than in 1898, and the liabilities in which are less than one-fourth as costly as they were last year, while the heaviest increase in liabilities is found in the Middle States group. Of iron and steel, Dun's says that the iron manufacturer has to meet a greatly increased cost of material next year. Prices for 1900 have

been fixed at $5.50 for Bessemer ore at lower lake ports, against $2.53 last year, and $4.25 for non-Bessemer against $2 last year, while coke at $2.75 for furnace, with high rail rates in every direction, indicates that iron will not be made next year as cheaply as it has been. Prices of pig still advance, according to the Iron Age, Bessemer to $25 at Pittsburg, with very small transactions, and Grey Forge to $21.25, quotations at other points being unchanged. Prices of some finished products are still yielding as works run out of orders and compete with each other for more business, and refined bar is $2 per ton lower at Philadelphia, common $2 per ton lower at Pittsburg, and plates $3 lower at Philadelphia, with further concessions in sheets because many of the tin plate works are now closed. Copper is easier at 17 cents.

ANDERSON (IND.) TRACTION SYSTEM.—The Union Traction Company, of Indiana, gives us some details of its extensive plans for its large network of trolleys. The power plant will be at Anderson, and there will be battery sub-stations at Muncie, Marion, Fairmount, Alexandria, Elwood, Daleville, Ingalls and Lawrence, where batteries of Chloride accumulators will be placed. The Electric Storage Battery Company will furnish these, as well as an outfit for the central power-house at Anderson. The generating equipment will comprise dynamos of 1000-kw each from the Westinghouse Electric & Manufacturing Company, boilers from the Babcock & Wilcox Company, each boiler of 400-hp, and three Rice & Sargent compound condensing engines of 2000-hp each, built by the Providence (R. I.) Engineering Company. There will be room for two more engines. The furnaces will be set for natural gas, but coal bins, with patent stokers and conveyors, will also be furnished. The smokestack will be 19½ feet in diameter at the base and 180 feet high. The Indiana Bridge Company, of Muncie, is furnishing the steel superstructure for four large bridges, and the Cambria Iron Company, of Johnstown, Pa., is supplying 70-pound steel rails in 60-foot lengths. The Shimer Woven Wire Fence Company, of Anderson, has contracted to build 45 miles of wire fence along the right-of-way between Muncie and Indianapolis. To carry the high voltage lines for distribution the poles, on one side of all the tracks, will be 40 feet high. The network comprises nearly 200 miles of road. Upon the completion of the new power house the old one at Anderson will be converted into a general repair shop and fitted up with modern tools, electric cranes, etc. A building 60x200 feet will also be erected nearby as a car body repair and paint shop. The new power house is 164x116 feet, 50 feet high in front, and the Indiana Brick Company is furnishing over 2,000,000 brick for the building and stack. Mr. P. Matter, of Marion, is president, and Mr. C. L. Henry, Anderson, secretary and general manager.

EXPORTS OF ELECTRICAL GOODS.—New York City shipped electrical goods during the week ending December 2 to the following countries: Amsterdam—1 package electrical material, $100. Argentine Republic—310 cases electrical material, $17,064; 35 cases electrical machinery, $5671. British Australia—158 packages electrical material, $17,994; 51 packages electrical machinery, $8150. British East Indies—23 cases electrical material, $1163. British Possessions in Africa—20 cases electrical material, $1893. Bristol—5 cases electrical machinery, $50. Cuba—44 cases electrical material, $1334; 15 cases electrical machinery, $155. Central America—84 cases electrical material, $1544. Chili—1 case batteries, $25. Canada—13 cases electrical material, $104. Cadiz—4 cases electrical material, $215. Cork—3 cases electrical material, $4000. Dutch East Indies—1 case electrical material, $32. Ecuador—25 packages electrical material, $1294. Florence—16 cases electrical material, $456. Glasgow—6 cases electrical material, $500. Genoa—7 cases electrical material, $262. Havre—6 cases electrical material, $384; 41 cases electrical machinery, $1551. Hamburg—222 packages electrical material, $5663; 4 cases electrical machinery, $4859; 25 cases electrical material, $3080. Liverpool—20 cases electrical machinery, $1208. London—180 cases electrical material, $4266; 27 cases electrical material, $1020. Mexico—65 cases electrical material, $140. Marseilles—89 cases electrical material, $15,032. Naples—68 cases electrical material, $3186. Peru—20 cases electrical material, $652. Sandwich Islands—6 cases electrical material, $2200. St. Petersburg—5 cases electrical material, $305. Swansea—8 cases electrical machinery, $2990. United States of Colombia—8 cases electrical material, $471.

THE ELECTRICAL INDUSTRY.—The following comments from Bradstreet's seem worthy of quotation in full: Installations of electric light and power plants or of electric railways are now so common and numerous as no longer to attract particular attention. In fact, it is hardly realized how important a feature the manufacture of the machinery and appliances required in this connection is in the general industrial activity of the country. When, however, as is shown by the report of the Pennsylvania State Railroad Department, it appears that the electric railroads of that one State represent a capitalization of nearly $100,000,000, and that their income from operations during the last fiscal year amounted to over $21,600,000, it may be possible to approximately grasp the significance of the industries which supply such concerns with their special mechanisms. It is also to be considered that, owing to the marked superiority of American electrical appliances over those produced in foreign countries, our export trade in this department has grown to enormous proportions. At all events, electrical manufacturing companies are generally understood to be earning at a rate which surpasses all expectation, and, as reflected by stock-market quotations for their securities, exceedingly favorable views are consequently held about their future. The rapid development of the industry naturally creates a need for additional capital, and it is not strange to find that Wall street hears reports that the General Electric Company, one of the two largest manufacturing concerns of its kind, not only in the United States, but in the world, is to increase its share capital to a considerable extent for the purpose of augmenting its facilities and manufacturing plants.

POWER ENTERPRISE FOR MEXICO.—The *Two Republics* (Mexico) states that on August 25, 1899, the organization of one of the most important companies ever placed on a business footing in the Republic was completed. This company is known as "La Campañía Mexicana de Fuerza Motriz," the capital stock fully paid up being $10,000,000 Mexican, subscribed in London, New York, Philadelphia and Mexico. One of the most encouraging features of the new organization is the large amount of Mexican capital interested, as it is a well known fact that Mexican capital is extremely cautious. The company has acquired rights for using the waterfalls throughout eight of the richest States of the Republic. The most important are the falls of the Rio Blanco, in the State of Very Cruz, which will be developed first, and work commenced at once. Over 7500-hp have already been contracted for by manufacturers from the United States and Canada, who will establish plants near the falls. In all, the company has at its disposal something like 150,000-hp. As will probably be understood, the object of the new company is to establish foreign, principally American, factories throughout the Republic and furnish power at a minimum cost to local industries. The company enjoys liberal concessions from the Government, and is favorably regarded.

AN ELECTRICAL PLANT FOR SOUTH AUSTRALIA.—At Pittsburg, Mr. James O. Callender, of Sydney, New South Wales, consulting electrical engineer of the Adelaide Development Company, of London, England, has, it is stated, placed a contract with the Westinghouse Electric & Manufacturing Company for the generating plant and equipment for the entire Adelaide traction system, the contract amounting to about $500,000. The Adelaide Company, backed by London capital, has secured control of all the tramway lines of that city, about sixty-five miles, and consolidated them. It was decided that the old horse power should give way to electricity, and negotiations were at once opened with the Westinghouse Company. Mr. Callender was sent to Pittsburg to examine the plant of the company and the different designs of apparatus. Mr. Callender said that the initial equipment would probably be 5,000-hp, and that the Westinghouse Company would furnish boilers, stokers, engines and all the electrical machinery for the plant complete. The contract was to be finished within twelve months, the company being anxious to operate fifty miles of their electric line by that time. Mr. Callender has already sailed for home, via Vancouver and Japan.

MATERIAL FOR BUENOS AYRES.—A large shipment of electrical equipment left last week by the steamship Riverton for Buenos Ayres, including ten trolley cars, manufactured by Barney & Smith, of Dayton, O.; motor trucks from the Peckham Truck Company, of Kingston, N. Y., and several double motor equipments with electric brakes from the General Electric Company. A number of Providence car fenders were also sent. The shipment, valued at close to $50,000, was made to the Buenos Ayres Electric Tramways through the South American Electric Company, of this city.

SANTIAGO, CHILI.—The Electric Street Railway Company, of Santiago, Chili, is to begin the construction of an underground system early in 1900. The road is to be 100 miles in length. It is understood that American as well as European manufacturers of apparatus, etc., will be asked to bid. Mr. S. B. Norton, of Santiago, Chili, is the engineer. The company's London office is at 120 Bishopsgate street, E. C., and English capital is interested in the work.

LARGE GAS ENGINES continue to be in demand and orders are being placed all the time. The Metropolitan Railway Carriage & Wagon Company, of London, have ordered from Westinghouse, Church, Kerr & Co. three 225-hp Westinghouse gas engines, and the Riter-Conley Manufacturing Company, of Pittsburg, have also placed with the same concern an order for four gas engines aggregating 500-hp.

TUPELO, MISS., is to open bids at noon on December 15 for a complete municipal electric light plant to cost $15,000. The engineer is Mr. Edward J. O'Beirne, of Birmingham, Ala.

# Special Correspondence.

## NEW YORK NOTES.

New York, Dec. 5, 1899.

UNDERWRITERS' MEETING.—The usual annual meeting of the electric committee of the Underwriters' National Electric Association will be held at the New York board rooms, 32 Nassau Street, this city, on Tuesday, Dec. 12, at 10 a. m. As in the past, the electrical inspectors in the employ of insurance and municipal departments are cordially invited to be present; also electrical engineers who are interested in the maintenance of the National Electrical Code.

ELECTRICAL TRADES SOCIETY.—By mistake notice was sent out stating that the annual meeting would take place at the Astor House on Monday, Dec. 4, 1899. According to the articles of incorporation, taken out last year, it was provided that the annual meeting should take place on the second Tuesday in December, beginning 1899. Hence the annual meeting this year will be held at the Astor House, Room No. 74, on Tuesday, Dec. 12, at 2 p. m., instead of on Monday, Dec. 4, as per previous notice.

RAILWAY AFFAIRS IN BROOKLYN.—The formal transfer of the property of the Kings County Elevated Railway to the Brooklyn Rapid Transit Company was made a few days ago. The Brooklyn Rapid Transit Company now controls all the elevated lines in Brooklyn Borough and 85 per cent. of the surface trolley mileage. The reorganization of the Kings County Elevated Company has been completed and that property will pass into the control of the Rapid Transit system by virtue of the sale of all its capital stock.

NEW TELEPHONE EXCHANGE.—The New York Telephone Company has filed plans with the building department for a new exchange building, to be erected on the southeast corner of Irving Place and Eighteenth Street. The building, which will cost $150,000, will be six stories high and constructed of brick. Mr. C. L. W. Eidlitz is the architect. The business at the Cortlandt Street Exchange of the New York Telephone Company has increased so rapidly lately that the company has decided to transfer a large number of subscribers' lines from that exchange to the John Street Exchange.

THE AUTOMOBILE CLUB OF AMERICA has engaged a suite of rooms at the Waldorf-Astoria. The board of governors will also obtain quarters for the storage and care of vehicles. A letter was received by the club from the Automobile Club of France, extending to any of its members traveling in France the use of its quarters. It was originally intended to limit the membership of the Automobile Club of America to 400, but the applications for membership are so much more numerous than expected that it is believed the club at its next meeting will increase the membership limit to 1000.

COMPRESSED AIR TRUCK.—"Autotruck No. 5," the first of the long-time heralded compressed air trucks, made its appearance on the streets in this city a few days ago. It seems to have been brought down from Providence for the inspection of Mr. Richard Croker prior to his departure for Europe. Mr. Croker is interested in the concern which manufactures these vehicles. It is stated that in the development of this truck the compressed air motor has been created anew. The truck is 16 feet long and has a capacity of 100-hp for 15 hours, carrying a load of 20,000 pounds. It is said to have worked well.

NEW TELEPHONE COMPANY INCORPORATED.—On Nov. 28, at Albany, N. Y., the Independent Telephone Company, of New York, was incorporated. It proposes to operate its lines in New York City and to connect with Montauk Point and other places eastwardly on Long Island and northerly to Rouse's Point and other places and westerly to South Ripley and other points. The capital stock is $100,000, and it may be increased to $20,000,000. The directors are Frederick Meyers, James J. Russell, C. W. Phillips and Henry Teneneck Wendell, of New York City, and Franklin Noble, Charles Tremaine and James C. Merwin, of Brooklyn. The company's offices are at 1123 Broadway.

AUTOMOBILE BUSSES.—It is stated that preliminary arrangements have been completed for the establishment of a system of automobile stages through the principal thoroughfares of Brooklyn, and to operate also between that borough and Manhattan over the new East River Bridge. A syndicate of Brooklyn capitalists and railroad men, organized by J. C. Church, formerly counsel for the Nassau Electric Company, has obtained the rights of the General Carriage Company to run automobile stages and other passenger vehicles in Brooklyn. It is understood that to all practical intents the syndicate will form a subsidiary organization in Brooklyn to the General Carriage Company, of New York.

FAST TELEGRAPH TESTS.—Experimental tests of the Pollak-Virag rapid telegraphy system were made on Nov. 26 over 1039 miles of wire between this city and Chicago. Signals consisting of the letters of the alphabet from A to G were sent at the rate of 60,000 an hour, but owing to the great amount of induction and interruptions of various sorts, no actual messages were transmitted. In the experiments two ordinary telegraph wires were used to form a complete metallic circuit. Josef Virag was at this end of the wire, while Herr Pollak was in Chicago. Among those who witnessed the test were Mr. A. S. Brown, electrical engineer of the Western Union Telegraph Company, and Mr. C. Shirley, manager of the Postal Telegraph Company's New York office. The Pollak-Virag system was described and illustrated in THE ELECTRICAL WORLD AND ENGINEER of July 15, 1899.

MR. J. H. M'GREW, secretary and manager of the Kester Electric Manufacturing Company, manufacturers of metal specialties, at 245 South Jefferson Street, Chicago, was in New York last week on an eastern trip, which has been very successful. Mr. J. F. Kester, president, well known for his work in arc lighting, has lately devoted his energies to the production of a line of solder, wire brushes for dynamos, motors, etc., and the demand that has sprung up already is enormous. The company's great specialty is a self-fluxing solder, made in wire form, containing many cells or divisions, each cell embodying the proper amount of flux. The joint is made in the usual way, and when it is hot enough the solder is applied, flowing easily and smoothly and making a neat, perfect job. Mr. McGrew, who is very happy over the results of his trip, reports a good trade in fuse wire, fuse strips and Kester soldering salts.

THE WATSON-STILLMAN COMPANY make a line of hydraulic presses for all purposes, hydraulic jacks, pumps, etc. They have a more extensive line than one would suppose from this simple statement. A representative of THE ELECTRICAL WORLD AND ENGINEER called there this week and found them exceedingly busy. He learned that their line includes about 1800 different kinds of tools. This does not include small fittings, etc., for hydraulic purposes. They are doing considerable work among the electrical companies just now. One of the large hydraulic presses which they are building is for the English Brush Electric Company, and will be used by them for forcing on armatures, etc. The working pressure of this press is 6000 pounds per square inch, and it is capable of exerting a force of 500 tons. They are also building one medium-sized hydraulic press for the Société Industrielle d'Electricité, of Havre, France, and two medium-sized hydraulic presses for the Westinghouse Electric & Manufacturing Company, Pittsburg.

REDUCTION IN TELEGRAM RATES TO CUBA.—On Dec. 1 the Western Union Telegraph Company reduced its rate on telegraphic messages between Havana, Cuba and New York and all places east of the Mississippi River, including St. Louis and Minneapolis, to 15 cents a word; the rate with all other places west of the Mississippi River is 20 cents a word. The old rates were respectively 25 and 35 cents a word. The company has just completed the laying of a new three-conductor cable between Miami, Fla., and Key West, Fla., and a new cable thence to Havana. For some months past the Commercial Cable Company has been endeavoring to obtain the privilege from the government to lay a cable to Cuba from the United States, but its efforts so far have been thwarted. Boards of trade and other commercial bodies in various western cities have petitioned the Secretary of War to break the monopoly held by the Western Union Telegraph Company and permit the Commercial Cable Company to land a cable on Cuban shores.

Niagara Falls, N. Y., Dec. 2, 1899.

NIAGARA POWER IN NORTH TONAWANDA.—It is announced that Becker Brothers, of Pittsburg, Pa., will start an overall factory in North Tonawanda, they having leased a building in that city. The factory will be operated by Niagara power.

POSSIBLE SALE OF MUNICIPAL PLANT.—Jamestown officials are having a discussion as to the advisability of selling the municipal lighting plant to a private corporation. A special committee reported to the council that the city was losing money in operating the plant, but in an interview Mayor Cooper defends municipal ownership.

THE J. B. SHANTZ BUTTON COMPANY, whose plant at La Salle is operated by Niagara power, has been purchased by a syndicate headed by Senator Lester H. Humphrey, who has associated with him S. B. Whitlock, J. C. Buxton, Warren W. Hawley and W. C. Guoinlock. The plant is to be enlarged and a new factory built in Warsaw.

THE MERCHANTS' ASSOCIATION, of this city, has secured the usual reduced rate in the territory of the Trunk Line Association of one and one-third fares for the round trip during the spring buying season. Applications for like reduction have been made to the Central Passenger Association and Southwestern Passenger Association. Similar applications to the Western Passenger Association and the Southeastern Passenger Association were declined.

## NEW ENGLAND NOTES.

Boston, Mass., Dec. 2, 1899.

CONVENTION OF RAILWAY SIGNAL MEN.—The annual meeting of the Railway Signaling Club was held at Young's Hotel in this city a few days ago. The first paper presented was by Mr. A. J. Wilson, assistant general manager of the Hall Signal Company, entitled "Automatic Signals." Mr. Wilson stated that automatic signals have been in service in this country, to a greater or less extent, for nearly 30 years, the first being applied on the Eastern Railroad of Massachusetts and the New York & Harlem Railroad of New York in 1871, by Thomas S. Hall, of Connecticut. Mr. Wilson's paper was devoted largely to a description and consideration of the cost of maintenance of the Hall system. A paper by Mr. H. M. Sperry, signal engineer and eastern agent of the Union Switch & Signal Company, on "Progress in Signaling," was next read. One of the things desired, he said, is a switch that cannot be locked in the wrong position. Some effort has been made in this direction in Great Britain, but it is the exception in this country. The evening session was devoted to a discussion of the various papers, and at a late hour the meeting adjourned.

## PENNSYLVANIA AND OHIO NOTES.

Philadelphia, Pa., Dec. 4, 1899.

MR. CHARLES M. WILKINS, of Partrick, Carter & Wilkins, who has been confined to his house through illness for about two weeks, has returned to business. Mr. Wilkins resides at Wenonah, N. J. His many friends will be glad to learn of his restoration to health.

AUTOMOBILES IN WILMINGTON.—It is stated that property owners on the Boulevard in Wilmington, Del., are organizing a company to run a line from the Philadelphia, Wilmington & Baltimore Railroad up Market Street to Ninth, to Washington and thence to the Boulevard and Concord turnpike.

NEW POWER PLANT.—The American Railway Company, of Philadelphia, which controls the Bridgeton & Millville Traction Company and the Bridgeton Electric Light Company, has purchased property in the business centre of Bridgeton, and will spend $100,000 in the erection of a new building and equipping a power plant for the two companies.

AUTOMOBILES IN FAIRMOUNT PARK.—Mrs. Jules Junker was recently arrested and fined for riding her automobile in Fairmount Park. The right to run these vehicles in the park is now to be tested, Mrs. Junker's case having been appealed to Common Pleas Court No. 3.

TO ENLARGE THE CUTTER FACTORY.—The Cutter Company, of this city, announces in a recently issued circular and price list of C—S switches that it will shortly double its factory capacity. By doing all of the work on its switches in its own factory, in large lots, the company states that it has been enabled to produce these goods to better advantage to all concerned.

PROF. BURSTALL, professor of mechanical engineering in Mason College, Birmingham, England, together with Prof. J. H. Pointing, professor of physics, and Director G. J. Kenrick, who have been visiting the United States in the interest of their new engineering building, spent the day on Nov. 25 going over the engineering plant of the University of Pennsylvania.

TO BUILD A CONNECTING LINK.—Within two months the Union Traction Company will have in operation a connecting trolley link between Manayunk and Germantown, the franchise for which was recently granted by councils under the caption of the Germantown & Fairmount Park Railway Company. This connecting line has long been a necessity and the project has received the favor of several thousands of residents in the two wards named.

STREET LIGHTING CONTRACTS AWARDED.—The department of public safety has awarded the contract for street lighting for the whole city next year to the Brush Electric Light Company, on its bids, which were as follows: 2101 lights at 31 cents; 4590 lights at 30 cents; 768 lights at 28 cents; 235 lights at 32 cents, making a total of $848,589.30. The bids of the various competing companies were given in the last issue of THE ELECTRICAL WORLD AND ENGINEER.

MESSRS. QUEEN & CO. have recently enlarged their factory by incorporating with it the building used formerly for their electrical laboratory, thus greatly adding to their facilities, more especially for the production of electrical instruments. The electrical laboratory has been removed to their building on Chestnut Street, occupying the space on the third floor. This change has been necessitated by the increased export demand for their instruments, some considerable sales having resulted from the recent Commercial Exposition in this city. Queen & Co. are also engaged at the present time in moving their glass factory and wood factory to larger and more commodious quarters.

TEST OF A NEW RAILWAY SYSTEM.—A practical demonstration of a new system of trolley car propulsion was given last week at Washington Park by the Union Electrical Construction Company. About one-quarter of a mile track was fitted up with the system and a car was run over the course very successfully. The system partakes of the third rail idea, doing without the overhead wire and the objectionable features of the third rail. The system has a conducting cable which lies in a covered conduit running the length of the track and between the rails. The circuit is completed and current furnished to the motors by a large magnet underneath the car, attracting the cable to the top of the conduit and against a copper strip, thus sending the current to the motors through trolley wheels, which run on corresponding strips of steel fastened on the outside of the conduit. Every five feet the strips on either side of the top of the conduit are broken by insulation, so that only that portion of the track directly under the body of the car is charged. The advantages of this system, as claimed by the inventor, are cheapness of construction, absolute safety and perfect action in all kinds of weather.

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Pittsburg, Pa., Dec. 2, 1899.

MR. JOSEPH CAREY, a well known local electrician, connected with the Price Electric Company, of Allegheny City, was killed the other day by being caught in the shafting at the Heyl & Patterson machine shops on Water street, this city.

MR. T. TSUNO, a special representative of the Japanese government, in charge of the coal mines of Japan, passed through here on his way home and visited the Westinghouse works with a view of purchasing electric mining apparatus for the Japanese coal mines.

JUDGE JOSEPH BUFFINGTON, of the United States Circuit Court, this city, yesterday took the papers in the case of the Western Electric Company, of Chicago, against the Anthracite Telephone Company, of Hazelton, Pa., in a case which involves the validity of a telephone system used on party lines, bridging the magnets at each telephone.

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Cleveland, O., Dec. 2, 1899.

THE CHILLICOTHE, CLARKSBURG & MT. STERLING ELECTRIC RAILWAY COMPANY secured a 25-year franchise in Ross County a few days ago and will construct a line between the points mentioned.

FIFTY-YEAR FRANCHISE GRANTED.—The Trumbull County commissioners have granted the Ashtabula-Warren Electric Railway a 50-year franchise to operate a line from Colebrook, through Greene, East Mecca, Bazetta and Courtland to Warren. Philadelphia capitalists are back of the road.

TO GIVE UP ELECTRIC HEATERS.—The Cleveland City Railway Company has decided to abandon the use of electric heaters for cars this winter. The electric heaters have been satisfactory to the patrons of the road, but they are said to be five times as expensive as a stove and coal, hence they will be given up.

MR. ALEXANDER WINTON, of the Winton Motor Carriage Company, Cleveland, is at work on a new design of motor which will be used in the racing carriage to be entered in the automobile race to be held next summer in connection with the Paris exposition. The race will be from Paris to St. Petersburg.

THE WHEELING STREET CAR COMPANY, of Wheeling, W. Va., has bought out the Moundsville & Benwood Electric Railway Company, paying $175,000 for the road, which is about 70 per cent. of the capitalized stock of the company. The Wheeling company now owns all the electric lines in that section of the Ohio Valley.

CABLE RAILWAYS.—The Cleveland City Railway Company has given up the project announced recently of abandoning its present cable lines and equipping them with electricity in the near future. The cable system is still in good order, and it is figured it would cost $2,000,000 to make the change; consequently, the directors have decided to wait.

THE TOLEDO & DETROIT ELECTRIC RAILWAY project, which has been hanging fire for some time, has secured the backing of Alex. Brown, J. M. Buckley, H. T. White, M. C. W. Harrah and P. M. Jacobson, all prominent Detroit business men. All claims against the old company have been taken up and the road will be pushed to completion.

THE STANDARD WELDING COMPANY, Cleveland, is preparing to employ its electric welding process in the manufacture of fittings and parts for automobiles. It is claimed that much of the brazing now necessary in building horseless carriage frames can be done away with. A representative of the company was in Chicago last week arranging for some of this work.

THE INDEPENDENT HOME TELEPHONE COMPANY, operating in the central portion of the state, was refused a 25-year franchise by the council of Canal Dover a few days ago. The commissioners offered a 15-year franchise, but as franchises granted in other towns in that section were given for 25 years and guaranteed communication with Canal Dover, a 15-year franchise would have the effect of rendering the others elsewhere in the county void after 15 years.

THE CENTRAL TRUST COMPANY, of New York, which holds 2325 shares of stock in the old cable railway company, now a part of the Cleveland City Railway Company, has brought suit against the latter company, claiming that since the consolidation of the two roads, the company will not redeem the stock nor recognize it nor pay dividends on it. The Trust Company claims damage to the amount of $55,000. It is said that other suits of the kind will be instituted against the Cleveland company very shortly.

CONSOLIDATION IN COLUMBUS.—The Columbus Electric Company and the Edison Electric Company, rival concerns at Columbus, have consolidated. The new company will have a capital of $3,000,000 preferred stock and $450,000 common. The Edison Company has a capital of $300,000 and the Columbus Electric Company $450,000. The consolidation of the two lighting companies places all of the semi-public utilities of that city in the hands of one man, Mr. Emerson McMillin. He controls the lighting, both electric and gas, and the street railroads of the city.

EXTENSIVE ELECTRIC RAILWAY.—Work will commence in the near future on the Tiffin, Toledo & Sandusky Electric Railway. It will aggregate about 100 miles in length and will open up one of the richest fruit sections of the world. One division will run from Tiffin, Old Fort and Fremont to Port Clinton; another from the latter point to Toledo, following the shores of Lake Erie, and the third division to Lakeside, Marblehead and Sandusky. There will also be a spur from Sandusky to Catawba Island. The power house will be at Port Clinton and will be modern in all respects, costing over $100,000. The projectors of the company are Washington capitalists.

EFFECTS OF THE RAILWAY STRIKE.—Reports just made public by the Cleveland Electric Railway Company show that the strike of last summer cost the company a very large sum of money. The gross earnings for August, the last month of the strike, were $46,424, against $148,237 for the same month last year. The gross earnings from Jan. 1 to Sept. 1 this year were $961,861, against $1,127,166 for the same time in 1898. The net earnings for the period were $330,990, as compared with $423,477 last year. The suburban electric roads operating from Cleveland have made decided gains. From Jan. 1 to Nov. 1 the gross earnings of the Lorain & Cleveland road were $79,664, against $61,510 in 1898. The Cleveland, Painesville & Eastern road earned $11,432 during the month of October, against $9,977 last year. The gross earnings from Jan. 1 to Nov. 1 were $103,539, against $90,070 in 1898.

THE NEW FEDERAL TELEPHONE COMPANY.—A meeting of the stockholders of the new Federal Telephone Company was held last Saturday in Cleveland to consider a proposition which had been made to the company by the proposed combine of independent telephone companies. After the meeting President H. A. Everett stated that they did not reach any decision as to whether they would accept the proposition or not, adding that the matter had not yet progressed far enough to make anything public. At the meeting it was decided to go ahead as rapidly as possible with the construction work in Cleveland. About 3000 telephones will be put into operation at once and the system will be in working order within two weeks. The company has recently contracted for 2000 additional miles of wire, which will be put up as rapidly as possible. About 2100 miles of wire are already built.

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Cincinnati, O., Dec. 2, 1899.

MR. C. B. HUMPHREYS, of the Westinghouse Electric Company, left to-night for New York City, where he will give testimony in an arc lamp suit.

PRESIDENT GEORGE BULLOCK, of the Bullock Manufacturing Company, returned from New York and his eastern trip in time to take Thanksgiving dinner with his family in Norwood.

THE SUBURBAN ELECTRIC COMPANY, of Covington, Ky., whose difficulties were referred to in these columns in the last issue, has been declared bankrupt by Judge Evans and a receiver will be named at once.

MR. J. B. PEVEAR, assistant manager of the Cincinnati department of the General Electric Company, spent Thanksgiving in Berkshire, Mass., with his father, Mr. H. A. Pevear, the first and only president the Thomson-Houston Company ever had. Mr. Peaver, sr., is well and hearty.

MR. FRANK H. TAYLOR, sales manager of the Westinghouse Electric Company, was in Cincinnati to-day on his way west. Mr. Taylor will visit Denver and Omaha, and expects to be absent a month in search of health and recretion. He was introduced into the handsome new quarters of the Business Men's Club to-day by Local Manager Humphreys.

BULLOCK GENERATORS FOR EGYPT.—The Alexandria Street Railway Company, of Alexandria, Egypt, has placed an order with the Bullock Manufacturing Company, through the Paris agency, for two 800-kw generators for the operation of the company's system in that ancient city. Delivery will be begun some time next August. This order was closed yesterday.

GENERAL MANAGER J. C. HOBART, of the Triumph Electric Company, is in the east. While there he will attend the annual meeting, the coming week, of the Society of Mechanical Engineers in New York. He also expects to visit Boston ere his return the latter part of next week. The Triumph Company shipped this week a car load of electric equipment to the Maryland Car Wheel Works, and next week another will follow. Two car loads went to Minneapolis a week ago.

THE BULLOCK COMPANY has just closed an order for one 50-hp, two 40-hp, one 30-hp and two 10-hp motors, and one 150-kw generator with L. L. Summers, of Florence, Colorado. The equipment is to be used in mining work. Among other domestic orders received recently by this company are three 800-hp alternating current machines for the Wilson Aluminum Company at Kanawha Falls, W. Va.; two 100-kw generators for the Gould Coupler Company at Depew, N. Y.; three 50-hp printing press equipments for the Philadelphia North American, and one 85-kw engine type generator for John Wanamaker, Philadelphia, and two 50-kw generators and eight printing press motors for L. Barta, the type foundry man of Boston. Among late foreign orders are three 50-hp printing press equipments for Arthur Pearson (Pearson's Magazine), London; one 30-hp printing press equipment to be operated in connection with the Goss printing press at the Paris exposition, and two 250-kw generators for the Manchester Sporting Chronicle, Manchester, England.

## WESTERN NOTES.

Chicago, Ill., Dec. 2, 1899.

THE CHICAGO ELECTRICAL ASSOCIATION will hold its next meeting on Friday evening, Dec. 15. Mr. E. S. Halsey will read a paper on Electric Meters. Mr. Halsey is the inventor of the Halsey maximum current recording attachment for motor meters.

FOOTBALL ENTHUSIASTS ON THE ELEVATED.—If the managers of the "Alley" Elevated Railway were to witness a modern football game perhaps they would not entertain so much antipathy toward a football crowd. A crowd of football enthusiasts recently gave vent to their emotions by demolishing electric lights in the cars, smashing the windows and throwing the seats out of the windows. The railway officials object to having football games held on their cars and refused to put on extra trains to handle the football crowds on Thanksgiving Day.

MORE TIME FOR THE NORTHWESTERN ELEVATED RAILWAY.—A resolution has been inrtoduced in the city council to extend the time for the Northwestern Elevated Railway to be in operation, from Dec. 31, 1899, to Oct. 1, 1900. Strikes and the prevailing scarcity of structural material are given as the causes for the delay in completing the road within the stipulated time. This is the fourth time this company, which is building more than 25 miles of steel elevated track and which is designed to carry a greater number of passengers when opened than any other street car system in Chicago, has asked for an extension.

CONSOLIDATION OF CHICAGO RAILWAYS.—A message a few days ago from New York contained the information that the deal by which the Union Traction Company will absorb the lines of the Consolidated Company in this city had been practically closed in that city. The details, however, are kept a secret. The Chicago Consolidated Traction Company was organized on March 4 of this year, with a capital stock of $15,000,000. It embraces the following companies: Chicago Electric Transit, Chicago & Jefferson Urban, Cicero & Proviso, Evanston Electric, North Chicago Electric, North Side Electric, Ogden Trust, These lines comprise what is known as the Yerkes system.

THE VICTOR TELEPHONE JOURNAL.—The first number of the *Victor Telephone Journal* has made its appearance. It is published in Chicago "every little while," and Mr. William T. Blaine is the editor. To be more definite Editor Blaine explains that the paper will be issued "as improvements, the accumulation of interesting information and other conditions make it desirable. This will probably be once a month." This is a sort of "go-as-you-please" journalism, but when it is considered that the paper is sent free its readers can have no just ground for complaint if they do not get a copy exactly on the moment. The first number is a creditable production. It contains 16 pages of reading matter, all about independent telephones and independent telephone people and their doings. We trust that the editorial responsibilities will rest lightly upon Editor Blaine's shoulders and that in lieu of a subscription price the reward for his labor will come in some other substantial way.

Milwaukee, Wis., Dec. 2, 1899.

THE NORTHWESTERN MALLEABLE IRON COMPANY is at work installing a large electric power and lighting plant. Messrs. Rohn and Meyer are building the switchboard.

THE FOND DU LAC STREET RAILWAY system will be extended to the new shops of the Wisconsin Central Railway Company. This line will be about three miles long and modernly built.

ELECTRIC LIGHT INVESTIGATION.—The city council of Kenosha has decided on an investigation into the method in which the Kenosha Light & Power Company is carrying out its contract with the city. Frequent complaints have been made of the poor quality of the light, and of the fact that many of the lamps in the streets are sometimes out.

THREE-PHASE PLANT IN A GLUE FACTORY.—The United States Glue Company, of Milwaukee, recently installed a three-phase alternating power and lighting plant. A 400-kw General Electric alternator, direct connected to a Filer Stowell Corliss engine, furnishes three-phase currents to motors aggregating 495-hp and also to arc and incandescent lamps. The plant is most complete in every respect.

TELEPHONE IMPROVEMENTS.—The Wisconsin Telephone Company has purchased property on Fifth Street, between Grand Avenue and Wells Street, as a site for a six-story brick building, which will be erected within the next few months. This deal will represent an outlay of $95,000. This new exchange on the west side will practically eliminate the distance charge for service over a mile. The most modern apparatus will be installed. A new automatic switchboard, the absence of which has caused subscribers and operators so much annoyance since the recent growth of the service began, will be installed in the main exchange within a month. The company now has 7000 subscribers, an increase of 100 per cent. during the year. At this rate 13,000 subscribers are expected before the close of 1900.

Indianapolis, Ind., Dec. 2, 1899.

ELECTRIC RAILWAY FRANCHISE GRANTED.—The county commissioners of Vanderburg County granted a right of way through the county to the Evansville & Suburban Electric Railway. The proposed line is to run from Evansville to Boonville, a distance of 26 miles. Dayton (Ohio) capitalists are backing the scheme.

ELECTRIC LIGHT COMPANY TAKEN OVER.—The General Gas, Electric & Power Company, of Connersville, has taken over or absorbed the Connersville Electric Light Company, and there has been a reorganization of the company, with George Griffith, of New York, as president, and P. S. Florea, of Connersville, secretary.

ANOTHER ELECTRIC SYSTEM ASSURED.—President McNary, of the Logansport, Rochester & Northern Electric Railroad Company, has given out the information that the contract for the construction of the road has been let to an eastern construction company, and that work will begin soon and be pushed during favorable weather. The proposed line extends northeast from Logansport to Kendallville, with a branch from Warsaw to Lake Winona, Indiana's popular summer resort. The line will be 126 miles long and will be equipped with local and through trains.

THE INDIANAPOLIS & LOGANSPORT LINE.—Final and satisfactory arrangements have been made through W. N. Gray, of Philadelphia, representing a syndicate of New York capitalists, and the Philadelphia Construction Company, to finance and construct the Indianapolis & Logansport Electric Railway. The road will be bonded for $2,000,000 at 5 per cent. interest, the loan to be first mortgage on the entire property. It was also decided to absorb the Logansport street railway and allow President Marott $175,000 for the property.

St. Louis, Mo., Dec. 1, 1899.

THE CENTRAL BELT RAILROAD COMPANY, Nov. 27, filed its acceptance of the franchise granted to it nearly two months ago.

NEW TRANSFER SYSTEM.—The street railway transfer system of the St. Louis Transit Company went into effect Dec. 1. Transfers are given at every point where one road crosses another. A complicated system has been devised to enable the company to keep tab on the transfers issued. A box is placed in every car and at the end of each trip the conductor must place in it duplicates of the transfer checks he has given out.

San Francisco, Cal., Nov. 27, 1899.

MR. JOHN I. SABIN, president of the Sunset and Pacific Telephone Companies, of San Francisco, recently returned from an extended tour of Europe.

MR. W. ROBERTS, of the Western Electric Company, was recently in San Francisco, while making a business tour of the Pacific Coast, and has gone to Los Angeles, Cal.

THE GENERAL ELECTRIC COMPANY, through its Pacific Coast Agency in San Francisco, has installed an electric power plant for the Y. & I. Plantation, Hawaii. There are two generators in operation at present.

LARGE WIRING CONTRACT.—The California Electrical Works, San Francisco, has been awarded a large contract for electric wiring for the new residence now in course of construction for John D. Spreckels.

RAILWAY FRANCHISE GRANTED.—San Jose, Cal., has granted a franchise for an electric railroad on Fifth Street from the northern limits of the city to San Fernando Street. The new road will be a feeder to the projected electric railway from San Jose to Alviso, the same capitalists being interested in both lines.

THE BUTTE CREEK ELECTRIC POWER & LIGHTING COMPANY has received a shipment of electric machinery for its water power electric station in Centerville, Cal. The first dynamo will supply 1000-hp to dredgers on Feather River. An additional generator is to be installed in January next, when it is probable that the town of Chico will be supplied with current for lighting purposes.

## CANADIAN NOTES.

Ottawa, Ont., Dec. 2, 1899.

COLONEL TOPPING, of Rossland, British Columbia, is agitating for the construction of an electric railway between Rossland and Trail.

THE OTTAWA CAR COMPANY, which makes a specialty of manufacturing electric cars, is running to its fullest capacity at present. It has orders from Troy, N. Y., and from lines projected and in operation in Quebec and Ontario provinces, and has also inquiries for cars from Germany and Russia.

TO CHANGE TO ELECTRIC POWER.—At a meeting of the stockholders of the Sarnia Street Railway Company, of Sarnia, Ont., the question of converting the line into an electric system was discussed. A by-law authorizing the directors to raise $60,000 by debentures for carrying out the work was passed.

AMERICAN RAILWAY OFFICIALS IN CANADA.—Mr. T. E. Mitten, general superintendent of the Milwaukee Electric Railway & Light Company, of Milwaukee, Wis., and Mr. E. W. Olds, superintendent of rolling stock in the same, were in Montreal for several days, for the purpose of acquiring information in connection with the working of the Montreal Electric Street Railway.

AUTOMOBILE FACTORY.—The authorities of the city of Toronto, Ont., have granted the National Cycle & Automobile Company, the Canadian end

of the American bicycle trust, the use of machinery hall of the Toronto exhibition buildings as a temporary factory, pending the erection of a permanent place of business in the city. The company pledges itself to have a new factory, which will cost $100,000, built before August next.

ELECTRIC POWER ENTERPRISE.—Mr. J. A. Culverwell, of Toronto, Ont., the promoter of the Burleigh Falls, Peterboro and Lindsay electric power enterprise, states that he has succeeded in making financial arrangements with a prominent New York banking house for the completion of the undertaking. The company will be called the Central Ontario Power Company. Burleigh Falls is situated 17 miles from the city of Peterboro, Ont., and 39 miles from the town of Lindsay, in the same circuit. Plans of the dam and power house have been completed, which are said to prove that the hydraulic development will cost less than any proportionate power development on the continent. The minimum flow of the water, in the dry season, shows 3000-hp, while the reservoir capacity adjacent to the falls will give 4500-hp during the hours of heavy load. Contracted revenue for lighting and power in the several towns was secured during the past summer to the amount of $50,000 per annum of five and ten years' duration. It is understood that work will be commenced shortly, the hydraulic development not being considered an extensive undertaking, the main dam being built and maintained by the governments as part of the Trent Canal system, which probably makes a saving of an expenditure of some $100,000. Three 700-hp generators and other requisite apparatus will be installed at the beginning and provision made in power house for further increase.

# General News.

## THE TELEGRAPH AND TELEPHONE.

THE CENTURY TELEPHONE CONSTRUCTION COMPANY, of Cleveland, Ohio, has been organized at Dover, Del., for the contracting and construction of telephone and telegraph lines; authorized capital, $100,000.

THE CHICAGO HOTEL TELEPHONE COMPANY has been incorporated at Chicago to manufacture telephones, electrical goods, etc. Capital, $25,000. Incorporators: W. H. Hunt, C. O. Smith, F. L. Clark, all of Chicago.

DULUTH, MINN.—The anti-Bell interests, now completing a local system at Minneapolis, are asking the right to enter Duluth with a long distance line connecting with all the anti-Bell systems of the northwest. It will probably be granted.

CHICAGO, ILL.—The present year will witness the greatest increase on record in the number of Bell telephone users in the middle west. The Central Union Company has since Jan. 1, 1899, increased 15,000 subscribers, and the Erie Company increased 32,207.

DES MOINES, IOWA.—The Lisbon Telephone Company has been incorporated with a capital of $10,000. Incorporators: W. C. Stucklager, J. Anracher, H. Bucher, E. Burd, W. C. Runkle, S. A. Kurtz, D. C. Hartung, J. R. Woods, R. J. Warg, all of Lisbon.

BOSTON, MASS.—The New England Telephone & Telegraph Company is gradually reducing its telephone rates. It latest announcement is a reduction in "desk telephone" charges from $180 to $168 per annum and it is giving rebates to old subscribers from April 1 to date.

NEVADA, MO.—The Missouri & Kansas Telephone Company reduced its rates on Dec. 1. The charge for business telephones will be $1.50 a month, and for house telephones 75 cents a month. The reduction is made because of the building of a new telephone line by Munsell & Co.

SPRINGFIELD, OHIO.—The Central Union Telephone Company is extending its lines through Clark county, connecting seven or eight subscribers to one line, which is then connected with the exchange. It is the intention to have the county thoroughly covered within the next few months.

PLAINFIELD, N. J.—The New York and New Jersey Telephone Company is making plans to extend its lines from Plainfield through North Plainfield township, in Washington Valley, to connect with the line that now runs from Summit to Neshanic, and expects to have the line completed by spring.

DAWSON, GA.—The Dawson Telephone Company has perfected arrangements by which the Bell telephone system is to be introduced here in the place of the system in use for the past several years. This will give Dawson long distance telephone connection with many places, including Atlanta.

THE WASHINGTON TELEPHONE & TELEGRAPH COMPANY has been organized at Trenton, N. J., with a capital of $1,500,000. The company is to engage in the telephone and telegraph business. The incorporators are Seymour Mandelbaum, Harry A. Parr, Thomas J. Hayward, S. Davis Warfield, James Bond, George R. Webb, all of Baltimore.

NEW HAVEN, CONN.—The Southern New England Telephone Company has made another reduction in rates affecting the 18 cities and all the boroughs except one in Connecticut. Under the new tariff the additional charge of $2 for multiplied service and $10 for single service for each half mile beyond the first half-mile from the central local exchange is abolished, and the present rate for the first half-mile is extended to all city and borough limits.

BETHPAGE, TENN.—The Macon County Independent Telephone Company has completed a line from Lafayette to Westmoreland, a distance of 16 miles. The county circuit now embraces Gamaliel, Ky.; Gainesboro, in Jackson County; Scottsville, Ky.; Cornwell, Fountain Run, Ky.; Alton Hill, Entia, Sullivan, Red Spring, Willette and Gibb roads. Dr. Lawson Simmons has been elected president of the company, and W. H. Carter secretary. The company will extend its line down the Scottsville pike to Gallatin, where it will establish an exchange in a few weeks.

ERIE CONFERENCE.—A meeting of the Erie Telephone Company's officials has been held in Chicago to consult over plans for the extension of the business: The party was composed of Chas. J. Glidden, president; J. P. McKinstry and H. J. Pettengill, vice-presidents; Hon. D. F. Morgan, general counsel; P. Yensen, general manager, Cleveland, Ohio; E. D. Trowbridge, general superintendent long distance service; Chas. L. Boyce, general superintendent of equipment; E. W. Bennett, general suprintendent of supplies, Chicago; P. G. Reynolds, general superintendent of construction; Chas. P. Wainman, general manager for Minnesota, North and South Dakota; Frederick A. Forbes, representing the executive department for Michigan; C. E. Nestor, chief contract agent; J. D. McLeod, general manager for Wisconsin; J. F. Land, general superintendent central division, Michigan, Detroit; George D. Sherman, general superintendent northern division Michigan, Marquette; Chas. E. Wilde, general superintendent southern division Michigan, Kalamazoo; Chas. A. Gates, general superintendent eastern division Michigan, Saginaw; Wm. J. Berry, general superintendent western division Michigan, Grand Rapids; Thomas L. Powell, general manager for Arkansas; J. E. Farnsworth, general manager north Texas, Dallas; E. K. Baker, general manager south Texas, Austin.

## ELECTRIC LIGHT AND POWER.

NORFOLK, VA.—The Norfolk Electric Company has been incorporated with a capital of $300,000. Incorporators: A. P. Warrington, D. L. Yoldman, C. W. B. Lane, M. H. Biernbaum, J. Weismann, all of Norfolk.

NEVADA, MO.—The Nevada Light Company shut down the electric street lights on Nov. 24, presumably for good. The city has had no dealings with the company for a year or more, taking the lights by the month from the local superintendent.

MALDEN, MASS.—It is announced that the Malden Electric Company, of this place, has been sold to a syndicate of New York and Philadelphia capitalists. The capital stock of the company is $175,000, while there is an issue of $100,000 in bonds.

RENSSELAER, N. Y.—The Rensselaer Lighting Company has been incorporated to manufacture gas and electricity. Capital, $50,000. Directors: John T. Kirk, Brooklyn; Leonard B. Lampman, Coxsackie; Charles W. Squires, New York.

HARRISBURG, PA.—The West Side Light & Power Company, of Charleroi, has been incorporated with a capital of $1000. Incorporators: W. M. Murdock, J. H. Bowers, C. F. Thompson, J. D. Berryman, T. B. Hastings, all of Charleroi, and others.

WHITE PLAINS, N. Y.—The East Chester Electric Company proposes to extend its powers and rights so as to include among its objects the manufacture, use, leasing, and sale of electricity for producing light, heat, or power, and has filed a certificate to that effect.

BROWNSVILLE, PA.—The electric light plant here was levied on a few nights ago, and executions were taken to satisfy the claims of Joseph H. Elliott, its president, and William H. Fischer, secretary, amounting to about $6000. Edward Brashear was placed in charge, with authority to run the works until the matter could be settled. The plant furnishes power for the street arc lights and many houses and business places.

HAMMONTON, N. J.—On the night of Nov. 27 an accident at the station of the Hammonton Electric Light Company caused damage to the large dynamo to the extent of $500 and the suspension of street lighting service. The company has been unfortunate lately in the matter of accidents, and has, it is stated, decided to furnish no more street lights, despite the contract which has seven years to run.

ROCKFORD, ILL.—The Rockford Edison Company has broken ground for the erection of a building 60x30 feet, to be used to house a large storage battery. This will be used to furnish the power for the street railway in the evening. During the day the dynamos not in use for furnishing lights will charge the storage battery, and when the machinery is needed in the evening at the time of the greatest demand for the incandescent and arc lights, the cars will be run by the reserve in the storage battery.

## THE ELECTRIC RAILWAY.

MATTOON, ILL.—There is an opening for a street railway in this place.

LORAIN, O.—The Lorain Street Railway Company has increased its capital stock from $200,000 to $750,000.

GALESBURG, ILL.—The Galesburg & Monmouth Rapid Transit Company has been incorporated with a capital of $200,000. Incorporators, Fred A. Seacord, Howard Knowles, Robert Chappell.

BRIDGETON, N. J.—It is stated that the Bridgeton & Millville Traction Company will soon absorb the Millville Traction Company and operate the lines in both cities and extend the system to Vineland.

PITTSBURG, PA.—The United Traction Company has been granted a right of way through Ben Avon. Under an arrangement the company is to charge 10 cents fare for the first eight years and five cents thereafter.

MAY BUY A PARALLEL LINE.—The Pennsylvania Railway Company has taken steps looking to the purchase of the new electric line running parallel with its line from Indianapolis to Greenfield, Ind. Rumor has it that it already has purchased it.

GALVESTON, TEX.—The Galveston City and Gulf City railway properties have been sold under decree of the United States Federal District Court, Mr. Jules Runge, of Galveston, being the purchaser. He has until Dec. 20 to pay the purchase money into the court.

BOSTON, MASS.—Philip L. Saltonstall was appointed receiver of the Norfolk Southern Street Railway Company by the United States Circuit Court on

Nov. 22, in a bill brought for that purpose by the Sterling Company, an Illinois corporation, which holds an overdue promissory note for $3000 indorsed by that company.

SPRINGFIELD, ILL.—All efforts up to the present time to bring the strike of street employees in this city to a close have failed. General Manager C. J. Minery, of the Springfield Consolidated Street Railway, refuses to recognize the union. One of the company's cars was badly damaged one night recently by dynamite placed upon the track.

ALBANY, N. Y.—The state board of railroad commissioners has approved of an increase of capital stock of the Greenwich & Schuylerville Electric Railway from $200,000 to $500,000. The board has also granted consent to the Oswego Traction Company to issue first and second mortgages at $100,000 and $200,000, respectively, for the completion of its road.

BANGOR, ME.—The fight between the trolley companies for franchises and localities of tracks has developed into a complicated situation. The object of the contesting trolley companies is the securing of a trolley line from Portland to Boston, but when this contest is settled the victorious company will have to meet another powerful opponent. The Boston & Maine Railroad has acknowledged that it will oppose the building of a trolley line to connect with Boston.

ELIZABETH, N. J.—The Riker syndicate, the Elizabeth & Westfield Electric road, has withdrawn its application for a franchise, and in doing so Mr. Riker intimated that it was ruinous to run a road under the conditions imposed by the ordinance which was before the council, and that the company would not renew its application, but would at once proceed to connect Elizabeth's suburbs with Newark. This action, it is believed, is final.

## NEW COMPANIES.

THE NIAGARA ELECTRIC EQUIPMENT COMPANY, of Niagara Falls; capital, $20,000; directors, Willis L. Adams, Niagara Falls; Thomas D. MacNoe and Ralph A. Kellogg, of Buffalo.

THE METROPOLITAN ELECTRIC COMPANY.—Jersey City, N. J., to produce and accumulate electricity, etc. Capital, $100,000. Incorporators: William A. Mitchell, Thomas P. Hornsey, Stephen A. Rudd.

THE SPERRY TROLLEY WHEEL COMPANY has been incorporated at Cincinnati to manufacture electric conducting bearings for trolley wheels. Capital, $25,000. Incorporators: S. M. Johnson, G. M. Gest and others.

THE GARTON DANIELS COMPANY has been incorporated at Keokuk, Iowa, to manufacture and deal in electrical supplies. Capital, $25,000. Incorporators: J. C. Daniels, W. R. Garton, L. J. Titus, M. H. Titus, J. V. E. Titus, all of Keokuk.

THE AUTOMOBILE COMPANY OF LOS ANGELES, of Los Angeles, has been incorporated to manufacture vehicles. Capital, $50,000. Incorporators: I. B. Dockweiler, C. Johnson, H. E. Carter, R. D. Morris, D. H. Laubersheimer, all of Los Angeles.

THE HATCH ELECTRIC SMELTING COMPANY has been incorporated at Green Bay, Wis., to manufacture electrical machinery for smelting. Capital, $2,000,000. Incorporators: F. E. Hatch, E. L. Graham, W. W. Anderson, C. C. Phelps, M. F. Tobin, all of Green Bay, Wis.

## PERSONAL.

MR. M. J. O'CONNOR, of Rainy Hollow, Haines Mission, Alaska, has returned to New York for a brief holiday and rest. He is a graduate of Columbia, and at one time actively engaged in electrical contracting. Now he is busy with copper mining and owns deposits worth millions, which he proposes to get.

MR. CHARLES OLMSTEAD, who died last week at Norwalk, Conn., was instrumental in forming the Norwalk & South Norwalk Electric Light Company, of which at one time he was president. One of his daughters is the wife of ex-United States Patent Commissioner Mr. J. S. Seymour, now residing in New York City.

MR. P. B. DELANY has not been seen very much around his wonted electrical haunts during the past two years. The reason may now be given, namely, cataract of both eyes. But a recent successful operation has restored his sight, and he will soon be welcomed back again by a host of friends and admirers. It is to be hoped he will resume electrical investigation and invention.

# Trade and Industrial Notes.

MR. WILLIAM OSWALD, electrical engineer, 330 Baronne Street, New Orleans, La., has sold out his business interests to Newman & Sprauley and retired from the electrical construction and supply business.

NEW BOILER HOUSE.—The Berlin Iron Bridge Company, of East Berlin Conn., is to furnish a steel boiler house for the Ansonia Brass & Copper Company, of Ansonia, Conn. The building will be covered with the Berlin Iron Bridge Company patent anti-condensation roof covering.

THE YORK MANUFACTURING COMPANY, York, Pa., has received a contract from Mr. S. B. Stewart, of Huntsville, Ala., for the necessary machinery to equip a six-ton ice-making and refrigerating plant.

MESSRS. F. B. WOODARD & CO., electrical engineers and contractors, Plattsburg, N. Y., have removed their business to Greenfield, Mass., where they will continue in the same line of work, and also act as manufacturers' agents.

MR. FREDERICK B. SLOCUM, who represented the Henry R. Worthington Company for the last five years, has again opened an office in Detroit, at Room 69, Newberry Building, where he is handling the A. A. Griffing Iron Company's Bundy steam specialties. Mr. Slocum is well known throughout Michigan.

FOCUSING ARC LAMPS.—In a well illustrated catalogue of 16 pages Baker & Fox, 83 Schermerhorn Street, Brooklyn, N. Y., describe the various focusing arc lamps, stands, rheostats, reflectors, lens boxes, etc., of their manufacture. The types are particularly applicable for photo-engraving, electric fountains, stage lighting, etc.

BUFFALO FEED WATER HEATER AND PURIFIER.—In a catalogue issued by Robert Learmonth, 200 Lafayette Avenue, Buffalo, N. Y., the Buffalo feed water heater and purifier is profusely illustrated and described in all of its details. An interesting feature consists in illustrations showing the manner of application of the heater to different types of boilers.

EXPANSION: A VITAL QUESTION.—This is the title of a pamphlet issued by the Globe-Wernicke Company, Cincinnati, Ohio. This concern manufactures labor-saving devices for office use, such as document files, cabinets, etc. The "elastic" cabinet is a great convenience to any business, especially an expanding business. The cabinet can be made to expand with the business.

MR. JAMES G. BIDDLE, 1038 Drexel Building, Philadelphia, in circular No. 315, entitled "New Apparatus at Special Prices," describes a considerable number of high grade electrical measuring instruments as well as psychological apparatus. The offer is attracting the attention of college professors and electrical engineers. Anyone interested in the matter would do well to write at once to Mr. Biddle for a copy of the circular.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., is certainly not lacking in enterprise. It has recently gotten out a very liberal quantity of trade literature. One pamphlet is devoted to telephone construction material and tools, another to the Knapp annunciator, and the third to bare and insulated copper and iron wire, and a folder tells all about the "Duplex" lamp guards. A couple of blotters with the December calendar are also included in the lot.

THE WESTERN ELECTRIC COMPANY'S constant potential enclosed arc lamp for alternating circuits, known as the Petite lamp, is claimed to be the only lamp operated upon the repulsion principle. The practical tests, extending over a period of the past six months, have shown that lamps constructed on this principle are for many reasons better adapted for the special class of service which they are called for. Great changes in voltages and frequency, irregularities in character and size of the carbons, affect the operation of these lamps but slightly. The demand for these lamps has steadily increased. A catalogue illustrating the Petite alternating arc lamp will be mailed to anyone upon request.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, states that the increase in the use of electric motors has been unprecedented. It is exclusive territorial agent for the Eddy Electrical Manufacturing Company, and reports that the demand for this apparatus has exceeded expectations. The small motors are of light weight, very compact, and of moderate speed, being well adapted for users requiring a small amount of power. The larger motors are of multipolar construction with cast steel frame. The steel of which this casting is made is of high permeability, which enables a machine of given output to be constructed of light weight. The Western Electrical Supply Company invites correspondence concerning this apparatus.

"THE METER RECORD BOOK," published by the Western Electric Company, contains 250 sheets, three on the same page, and perforated so that they may be torn out. Each form is numbered consecutively. There are four sets of books, numbered from 1 to 4. In book 1, the forms are numbered from 1 to 250; in book 2, from 251 to 500; in book 3, from 501 to 750, and in book 4, from 751 to 1000. The meter man marks on the facsimile of the dial, with a lead pencil, the exact position of the hand on the meter dial. The form is returned to the office, proper extensions are made, and the slip is filed for reference. In some instances, where different methods of taking records of meters are used, the man who reads the meters carries a book of this description in his pocket and leaves the record of the meter readings with the house owner. Every central station should be supplied with such meter record books. Copies of the same can be procured from the Western Electric Company.

THE COLUMBIAN ELECTRIC CAR LIGHTING & BRAKE COMPANY, 11 Broadway, New York, is now operating its system of car lighting on the following named railways: The New York Central, Pennsylvania, Baltimore & Ohio, Boston & Albany, Union Pacific, Rutland, Illinois Central, Lake Shore, Canadian Pacific and the Big Four; also on Wagner cars and Pullman cars. The system ventilates as well as lights the cars, the power being derived from the car axle. The system is claimed to be a distinct departure from any other known method of lighting cars by the power obtained from the revolving axle. Its method of operation is absolutely automatic. The Columbian Company controls the Lindstrom lever brake for steam railway and trolley cars. The Skinner electric brake for trolley cars, also owned by this company, has been run successfully for many months and was recently successfully tested before the railroad commissioners in New York City. The same company is also owner of the Syracuse storage battery, which is said to be a most efficient and durable battery.

INCREASED RATE OF COMBUSTION.—Independently of the greater economy and higher rates of combustion mechanical draft stands as the only means by which the increased rate can be economically obtained. Coincidently the boiler capacity must of necessity be greater, provided the grate area is maintained. The expense or inconvenience of a chimney, to obtain rates above 20 or 25 pounds per square foot per hour, becomes so great as to practically preclude an increase. As observed by A. J. Durston, "as long as draft was dependent upon a funnel for its production, a much greater combustion than 25 pounds of coal per square foot of grate was rarely achieved; with artificial draft, on the other hand, the rate of combustion may be accelerated to any amount, and as a boiler's capability of transmitting heat without injury to itself is simply a matter of degree, experience has been necessary to determine

the rates of combustion that can with safety be employed with different types of boilers." When it is considered that in boilers of the marine type the combustion rate resulting from the employment of mechanical draft is now carried as high as 40 to 50 pounds, that in torpedo boat and similar service a rate of 70 to 80 pounds is frequent, and in locomotive practice as high as 120 pounds is not at all unusual, the possibilities of increased rates of combustion with mechanical draft are evident. The above is from a Treatise on Mechanical Draft, published by B. F. Sturtevant Company, Boston, Mass.

# Record of Electrical Patents.

UNITED STATES PATENTS, ISSUED NOV. 28, 1899.

[In Charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

637,766. MEANS FOR DRIVING DYNAMOS FROM CAR AXLES; J. L. Creveling, New York. App. filed July 30, 1898. This is an arrangement whereby an endless belt may be used to drive the dynamo from the axle, without passing the belt around the axle, thereby avoiding a splice in the belt.

637,773. CONSTANT CURRENT TRANSFORMER; R. Fleming, Lynn, Mass. App. filed June 6, 1898. (See Current News and Notes.)

637,778. ELECTROMAGNETIC INSTRUMENT; G. E. L. Grabe, Berlin, Germany. App. filed Aug. 4, 1899. A weatherproof casing for the instrument, in which one wall is a flexible diaphragm to which an armature and circuit controlling contacts are attached, the diaphragm thereby serving as a part of the case and as the armature lever.

637,785. PROTECTING STATIC VOLTMETERS; M. Hewlett, Schenectady, N. Y. App. filed July 15, 1898. In connection with an electrostatic instrument, there is used an impedance in series relation thereto and to the source of energy, the impedance being sufficiently high to prevent the maintenance of an arc if the potential rises sufficiently to leap the air gap between the fixed and movable members.

637,789. COMBINED RELAY AND DISTRIBUTER; K. Himrod, J. Tucker and C. C. Hinkey, Chicago, Ill. App. filed March 10, 1899. The relay comprises a permanent magnet, two neutralizing coils, down-turned pole pieces and an armature normally maintained almost in contact therewith and movable toward the coils. The instrument is adapted for use in connection with the Baudot type of printing telegraph.

637,794. LIGHTNING ARRESTER; T. B. Hughs, Hawes Cross Roads, Tenn. App. filed June 22, 1899. A switching device is used in connection with the arrester whereby the circuit of a local instrument may be thrown onto the main line at will or the main line connected with the arrester.

637,806. PNEUMATICALLY OPERATED CONTACT SHOE FOR ELECTRIC RAILWAYS; S. H. Libbey, Schenectady, N. Y. App. filed Sept. 7, 1897. A pneumatic motor is used for moving the shoe into and out of contact with a third rail.

637,812. TROLLEY; F. H. Merrill and W. Woodsome, Portland, Me. App. filed March 27, 1899. A pivoted fork normally stands above the trolley wheel and prevents it from leaving the wire, but may be pulled downward by a cord when it is desired to remove the wheel.

637,819. SYSTEM OF DISTRIBUTING ALTERNATING CURRENTS; E. G. P. Oelschlager, Westend, Germany. App. filed Sept. 19, 1898. (See Current News and Notes.)

637,825. ARC LAMP; I. R. Prentiss, Schenectady, N. Y. App. filed Aug. 12, 1899. With this device a record of the time during which the lamp is in service is kept. It comprises a wheel train and connections with the lamp for releasing it when the arc is burning and for automatically storing power from time to time in the driving mechanism of the wheel train.

637,828. SYSTEM OF ELECTRICAL DISTRIBUTION; E. B. W. Reichel, Berlin, Germany. App. filed Oct. 15, 1898. (See Current News and Notes.)

637,833. ELECTROHYGIENIC APPARATUS; A. Schneider and A. Schneider, Chicago, Ill. App. filed March 17, 1898. The well known exercising apparatus, consisting of elastic cables working over pulleys and provided with handles, is fitted with electric circuits, battery, etc., whereby a person exercising may receive current through the body at the same time.

637,846. ELECTRIC AND SELECTIVE SIGNALING; J. A. Barrett, Summit, N. J. App. filed June 8, 1899. A discovery where a polarized electromagnetic signaling instrument, instead of moving to one pole or the other of the magnet with which it is associated and remaining there when the magnet is placed in circuit with a source of steady current, is enabled to rapidly vibrate.

637,884. TELEPHONE CIRCUIT; J. J. Müller, Kiel, Germany. App. filed June 2, 1893. (See Current News and Notes.)

637,886. ELECTRIC ARC LAMP; G. L. Moyer, Hartford, Conn. App. filed Feb. 13, 1899. Details of the clutch, the frame for storing the resistance and the devices for holding the globe.

637,873. APPARATUS FOR INDICATING DIRECTION OR ROTATION OF MOTORS; H. Kahler, Hamburg, Germany. App. filed April 7, 1899. Specially adapted for marine engines to indicate to the pilot whether his signals have been obeyed. Devices are attached to the engine which operate electric circuits controlling indicators at the pilot house for showing the direction or rotation of the engines.

637,890. ELECTRIC CUT-OUT; C. G. Perkins, Hartford, Conn. App. filed June 28, 1897. The supporting frame is in two parts and the connectors for the fuse and wires are so disposed with reference to certain channels that the fuse is completely isolated from the contacts when the two parts are properly associated.

637,891. FUSIBLE PLUG; C. G. Perkins, Hartford, Conn. App. filed June 30, 1899. Details of construction for cheapness and simplicity.

637,892. ELECTRIC SWITCH; C. G. Perkins and J. Tregonning, Hartford, Conn. App. filed June 2, 1899. Relates to the construction of the receptacles for rotary snap switches, the method of securing the receptacles to their supports, the provisions for the entrance into the receptacle and the connection therein of the circuit wires.

637,894. TERMINAL HEAD BOX; A. G. Procunier, Chicago, Ill. App. filed March 29, 1899. The box is adapted to be attached to a pole and is constructed to be self-ventilating, weatherproof and easy of access.

637,905. CHANGEABLE ELECTRIC LIGHT SIGN; H. Trip and G. E. Stephenson, Chicago, Ill. App. filed June 19, 1899. Each letter, made up of a number of lamps attached to a single frame, is placed against a main board having slots through which the conductors pass.

637,914. ELECTRIC ALARM SYSTEM AND APPARATUS FOR TESTING SAME; C. F. Woodman, Boston, Mass. App. filed March 9, 1899. A protective system comprising a main alarm circuit, including one or more devices to change circuit under abnormal conditions, a test indicating device therefor, one or more local circuits each having an indicating device responsive to a change in the main circuit, and a testing apparatus adapted upon operation to connect such test indicating device with the main circuit and through the latter to effect the operation of the local circuit indicating device, whereby the condition of the main and local circuits will be indicated.

637,969. EXTENSION BRACKET; W. A. Nordyke, Indianapolis, Ind. App. filed Oct. 26, 1898. A sectional bracket with interlocking parts whereby its size may be made to suit the number of cables which it is to support.

637,979. INCANDESCENT ELECTRIC LIGHT AND PROCESS OF MAKING SAME; W. L. Lawrence, London, England. App. filed Feb. 28, 1898. (See Current News and Notes.)

637,992. ELECTRIC LOG RECORDER; L. T. Jones, Jr., San Francisco, Cal. App. filed Aug. 4, 1899. By means of this device the record and registration of a ship's log may be transmitted to the pilot house or other desired point for instant and continuous observation by the navigator.

638,011. ELECTRIC METER; E. S. Halsey, Evanston, Ill. App. filed March 17, 1899. In connection with a maximum meter a motor is used whose armature shaft is in two parts connected by an elastic coupling, a suitable detent being used to prevent one part, which registers the maximum, from returning when the other partakes of any backward movement.

638,020. CIRCUIT CLOSING AND INTERRUPTING DEVICE; F. Kuhlo and C. Ecker, Berlin, Germany. App. filed May 17, 1899. Consists of a mechanism by means of which a spring is put under tension when the circuit is closed, the spring acting to interrupt the circuit when a certain quantity of a liquid has been sucked through a restricted opening.

638,026. AUTOMATIC SIGNALING AND TRAIN STOPPING DEVICE; S. J. McCart, Appleton, Wis. App. filed June 3, 1899. The track is divided into insulated sections and the trains carry contact devices and signaling apparatus whereby when two trains are on the same section notice of the fact will be given to each of them and collisions avoided.

638,036. ELECTRIC SWITCH; H. P. White, Philadelphia, Pa. App. filed March 7, 1899. A knife switch in which provision is made for taking up wear between the clips and the blades, consisting in doubling each side of the clip to give it the form of an inverted U, one end being held and the other free to act against the blade.

638,038. PRIMARY BATTERY; H. Blumenberg, Jr., and C. Overbury, New York. App. filed Dec. 12, 1898. In a two-fluid cell a cover is used which can easily be removed, and from it are suspended both electrodes, one of which is deposited in a cup from which it may be easily removed and fresh material supplied, one of the objects being to insure an equal distance between the electrodes at all times.

638,039. BATTERY COMPOUND; Henry Blumenberg, Jr., New York, N. Y. App. filed April 7, 1899. (See Current News and Notes.)

638,040. BATTERY COMPOUND; Henry Blumenberg, Jr., New York, N. Y. App. filed April 7, 1899. (See Current News and Notes.)

638,041. BATTERY COMPOUND; Henry Blumenberg, Jr., New York, N. Y. App. filed July 20, 1899. (See Current News and Notes.)

638,042. BATTERY COMPOUND; Henry Blumenberg, Jr., New York, N. Y. App. filed Sept. 8, 1899. (See Current News and Notes.)

638,047. TROLLEY WIRE CLEANER; R. Dunning, Buffalo, N. Y. App. filed March 14, 1899. A scraper adapted to be attached to a trolley head and consisting of a plate of concavo-convex cross-section which is curved to conform to the periphery of the trolley wheel and provided in its concave face with a transverse scraper rib and in the walls of said face with openings for the escape of material scraped from the wire.

638,050. ELECTRIC HEATER; E. E. Gold, New York. App. filed Feb. 18, 1898. The invention relates chiefly to the means for supporting and enclosing a heater and the terminal connections thereof.

638,055. OSCILLATING METER; A. Lotz, Berlin, Germany. App. filed Dec. 29, 1897. A suitably supported swinging coil is connected to the winding of a relay affecting the operation of the registering mechanism and of a current changing mechanism, which relay is so connected in circuit with the coil through which main current flows that the oscillations of the relay armature are caused by the movement of the coil. The oscillations of the coil are limited by stops or contacts which are connected with the winding of the relay so as to short circuit the relay to cause an oscillation of its armature and reverse the direction of oscillation of the swinging coil of the meter by reversing its magnetization.

638,070. DYNAMO ELECTRIC MACHINE; W. B. Sayers, Bearsden, Scotland. App. filed Sept. 28, 1898. (See Current News and Notes.)

638,083. CHEMICAL GENERATOR OF ELECTRICITY; E. L. Anderson, St. Louis, Mo. App. filed Oct. 4, 1898. (See Current News and Notes.)

638,084. ELECTRIC CUT-OUT APPARATUS; L. Andrews, Hastings, England. App. filed April 4, 1898. Cut-out apparatus, comprising fixed and movable contacts, a loaded knockout device separated from and adapted when released to strike the movable contact into its open position and break the circuit between the fixed contacts, a trip or releasing device for controlling the movement of said knockout device, and an electric motor having a pivoted armature adapted when stationary to hold said trip and knockout devices in position and when partly rotated in one direction to release said trip and permit the knockout device to open the cut-out.

638,085. SYSTEM OF ELECTRICAL DISTRIBUTION; Leonard Andrews, Hastings, England. App. filed April 4, 1898. Automatic cut-out apparatus is provided in connection with the outgoing and return feeders near their points of connection with each substation, which apparatus is so constructed and arranged that it will carry as heavy a current as the feeders so long as the electric energy is being supplied from the generating station to the distributing station, but will cut out with a comparatively small current returning to the generating station. The construction, moreover, is such that interruption in the supply of energy in the generating station will have no action on the apparatus. The main feeders between the generating stations and substations and also, if necessary, the auxiliary feeders between the substations, are provided as usual with excess-current cut-outs at points near where they pass outward from the generating and substations.

638,101. TELEGRAPH INSTRUMENT; J. L. Cutler, Cincinnati, Ohio. App. filed April 7, 1899. To one end of the core of the magnet is fixed a U-shaped iron bar passing around each side of the magnet and presenting its poles in line with the pole at the opposite end of the core. These poles act against a three-piece armature, the idea being to make the instrument more sensitive.

638,110. STARTING SWITCH; J. W. Gibbs, Liverpool, England. App. filed July 3, 1899. Two controlling handles are used having interlocking connections whereby the mechanism must be set in a certain way before the levers can be thrown to cut out resistances, etc.

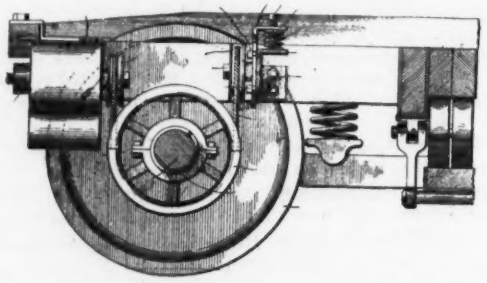
638,125. ELECTRIC ARC LAMP; W. C. Johnson and A. Underlich, London, England. App. filed April 4, 1899. The invention consists in features of construction relating principally to the clutching devices.

638,128. ELECTROMAGNETIC ORE SEPARATOR; C. Kreuser, Mechernich, Germany. App. filed Feb. 28, 1899. The separator consists of a pair of oppositely revolving cylindrical electromagnets and to the polar face of one magnet is closely fitted a covering of non-magnetizable material whereby the poles of this magnet are prevented from attracting the ore while at the same time they co-operate in producing the necessary flux or magnetic lines of force, and also serve to convey the ore to and from the magnetic field.

638,129. ELECTROMAGNETIC ORE SEPARATOR; C. Kreuser, Mechernich, Germany. App. filed May 12, 1899. In this separator, which is of the same general type as the preceding, the magnetic cylinders are maintained at a constant polar distance apart by rings on their bearings which rest against each other.

638,148. ELECTRIC BELT; A. T. Sanden, New York. App. filed Feb. 18, 1899. The essential feature of this improvement is a construction of the bearing pads for simple and convenient detachable application of a sponge-insulating-bearing surface, to be charged with water and located between a metallic disk and the body of the wearer.

638,150. MEANS FOR CONTROLLING ELECTRICALLY MOVED APPARATUS; G. E. Sautter, Paris, France. App. filed Feb. 20, 1896. By this invention it is intended to provide means by which the movement of a mechanism or structure may be intelligently controlled both as to its range and direction, by apparatus located at a distance or concealed from the body or structure controlled, at a point from which said body or structure is invisible. The mechanism involves two sets of resistances electrically connected and devices whereby changes in one set of resistance at the transmitting end will be similarly responded to by the resistance at the receiving end, which in turn acts upon the mechanism to be controlled.



637,766.—Means for Driving Dynamos from Car Axles.

638,152. TELEPHONY; J. S. Stone, Boston, Mass. App. filed Dec. 15, 1896. (See page 902.)

638,155. ELECTRIC RAILWAY; E. Warwick, Chicago, Ill. App. filed March 18, 1899. The invention consists in the means for mounting the conductor in a conduit system.

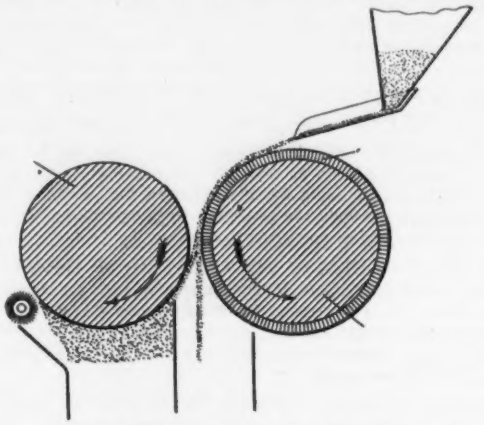
638,157. SYSTEM OF ELECTRICAL DISTRIBUTION; E. Wilson and J. McI. Cater, London, England. App. filed June 16, 1899. (See Current News and Notes.)

638,159. CARBON HOLDER FOR ELECTRIC ARC LAMPS; F. S. Worsley, London. App. filed Nov. 22, 1897. The carbon holder is provided with a removable bushing, so that different sizes of carbons may be held therein.

638,160. ELECTRIC CLOCK; H. E. Andersson, Stockholm, Sweden. App. filed Feb. 16, 1899. In this self-winding clock the striking mechanism is so connected with the spring of the time-train that at each blow struck by the hammer the spring is partly wound up.

638,186. SURFACE CONTACT ELECTRIC RAILWAY; D. Robertson, Jr., Uddington, Scotland. App. filed March 20, 1899. Two sets of surface contacts are used, one of which is high potential and the other low potential; the low potential set is always alive, but is not dangerous to persons or animals. The high potential set is automatically connected to the vehicle as it proceeds along the roadway.

638,199. ELECTRIC SWITCH; F. A. Merrick, Johnstown, Pa. App. filed Sept. 24, 1898. This is a canopy switch constructed to be capable of breaking, with certainty, an excessively large flow of current of high potential.

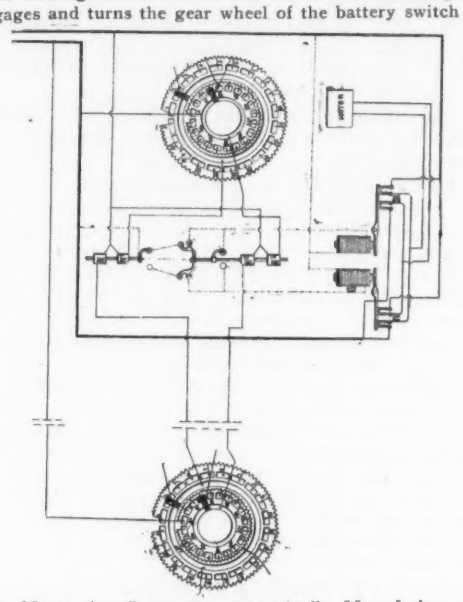


638,128.—Electromagnetic Ore Separator.

## GERMAN PATENTS, ISSUED NOV. 15, 1899.

[In Charge of Dr. Ralph Julian Sachers, 120 Liberty Street, New York.]

104,016. CURRENT CONTROLLER FOR ELECTRIC MOTORS; Union Electricitats Gesellschaft, Berlin. App. filed Nov. 23, 1897. A sector of a gear wheel is connected to the axle of a current-controller, which sector meshes into a gear wheel, fitting loosely on the axle of a rotary battery switch. On this second gear wheel there is located eccentrically a pin with a clutch, engaging a rachet wheel fastened to the axle of a battery switch. In turning the handle of the controller to the right, the geared sector engages and turns the gear wheel of the battery switch without actuating the switch. In turning the handle to the left, the clutch on the gear wheel of the battery switch engages the rachet wheel and thereby actuates the switch.



638,150.—Means for Controlling Electrically Moved Apparatus.

104,595. SAFETY PLUG; Voig and Haffner, Frankfurt. App. filed Sept. 23, 1898. The plug is provided with a radial metallic connecting piece, which may be used to close any of a number of adjoining circuits.

104,886. BRAKE MECHANISM FOR CURRENT CONTROLLERS; F. Klockner, Cologne. App. filed July 31, 1898. The switch lever is provided with a gear sector, the circumference of which is embraced by a brake piece. This brake piece consists of a segmental lever, one end of which is connected to a pin, the other to a spiral spring, pressing it against the gear sector. The action of the brake by turning it in one direction is increased, and by turning it in the other direction, is diminished.

105,338. ELECTRICAL MACHINE; Marcey Leland Whitfield, Chicago, and Charles Clifton Cowan, Memphis. App. filed Sept. 21, 1898. The field magnet of an electrical machine is provided with cylindrical hollow spaces for pistons. The machines may be used as a steam-dynamo, an electric pump, etc., etc.